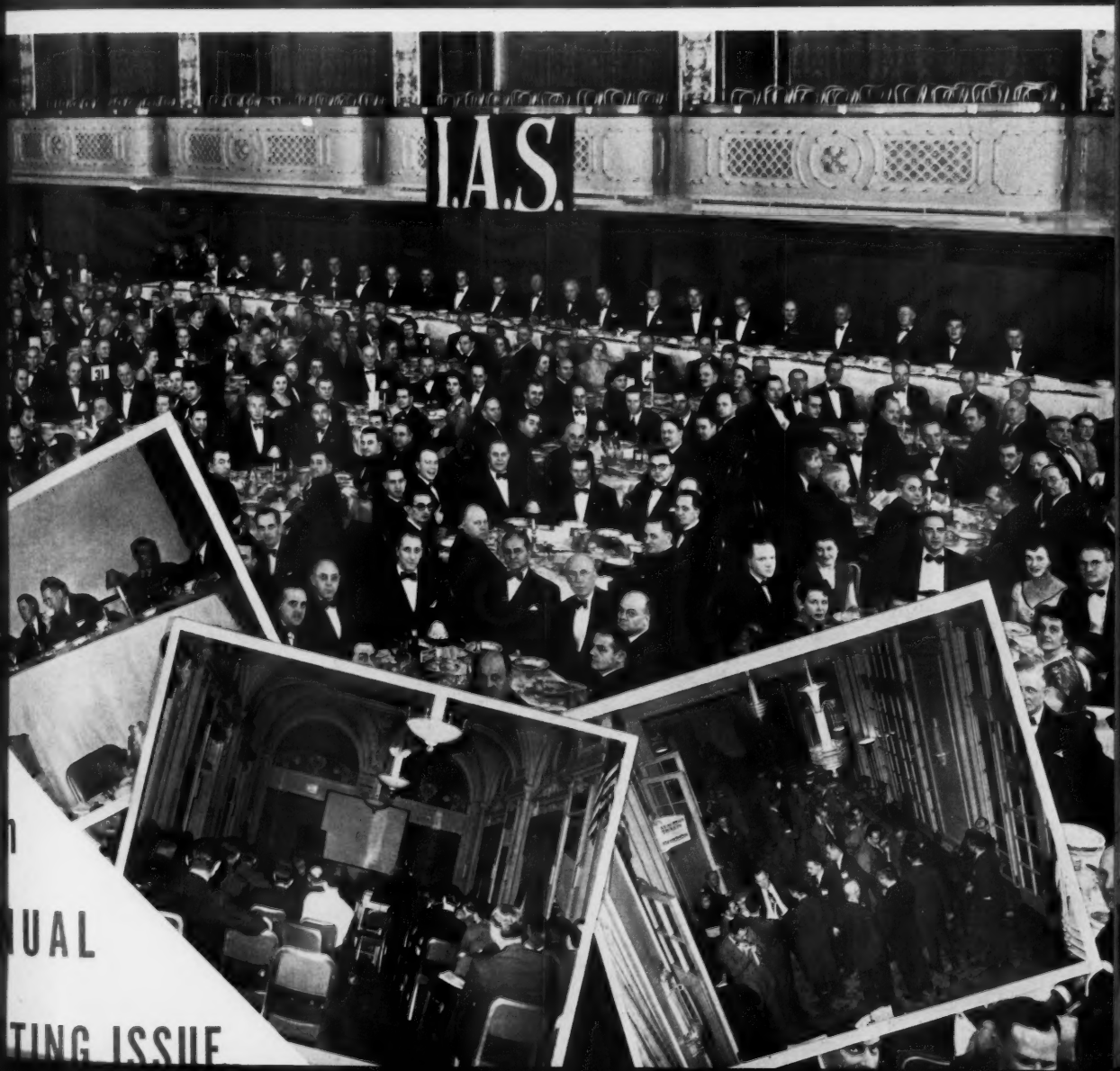
AERONAUTICAL ENGINEERING REVIEW

INSTITUTE OF THE AERONAUTICAL SCIENCES

MARCH 1950



NUAL

TING ISSUE

The Navy's AD-2
Skyraider
The AD-2 Skyraider is the standard carrier-based attack airplane of the U. S. Navy. Now in production at Douglas Aircraft's El Segundo Plant, it is recognized as possessing the ideal characteristics for carrier operations.
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The Douglas AD-2 is another of the famous aircraft — both conventional and jet-propelled — which rely on Clifford Feather-Weight All-Aluminum Oil Coolers.

Superior strength-weight ratio derived from Clifford's patented method of brazing aluminum and accurate performance ratings obtained in the Clifford wind tunnel laboratory — largest and most modern in the aeronautical heat exchanger industry — account for the rapidly growing acceptance of Feather-Weight Oil Coolers.

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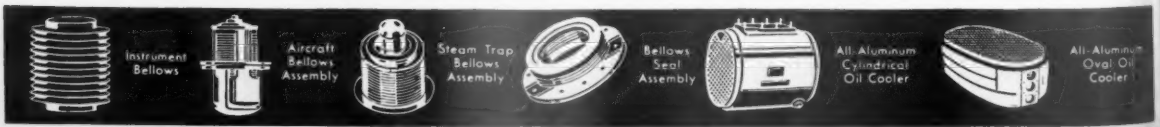
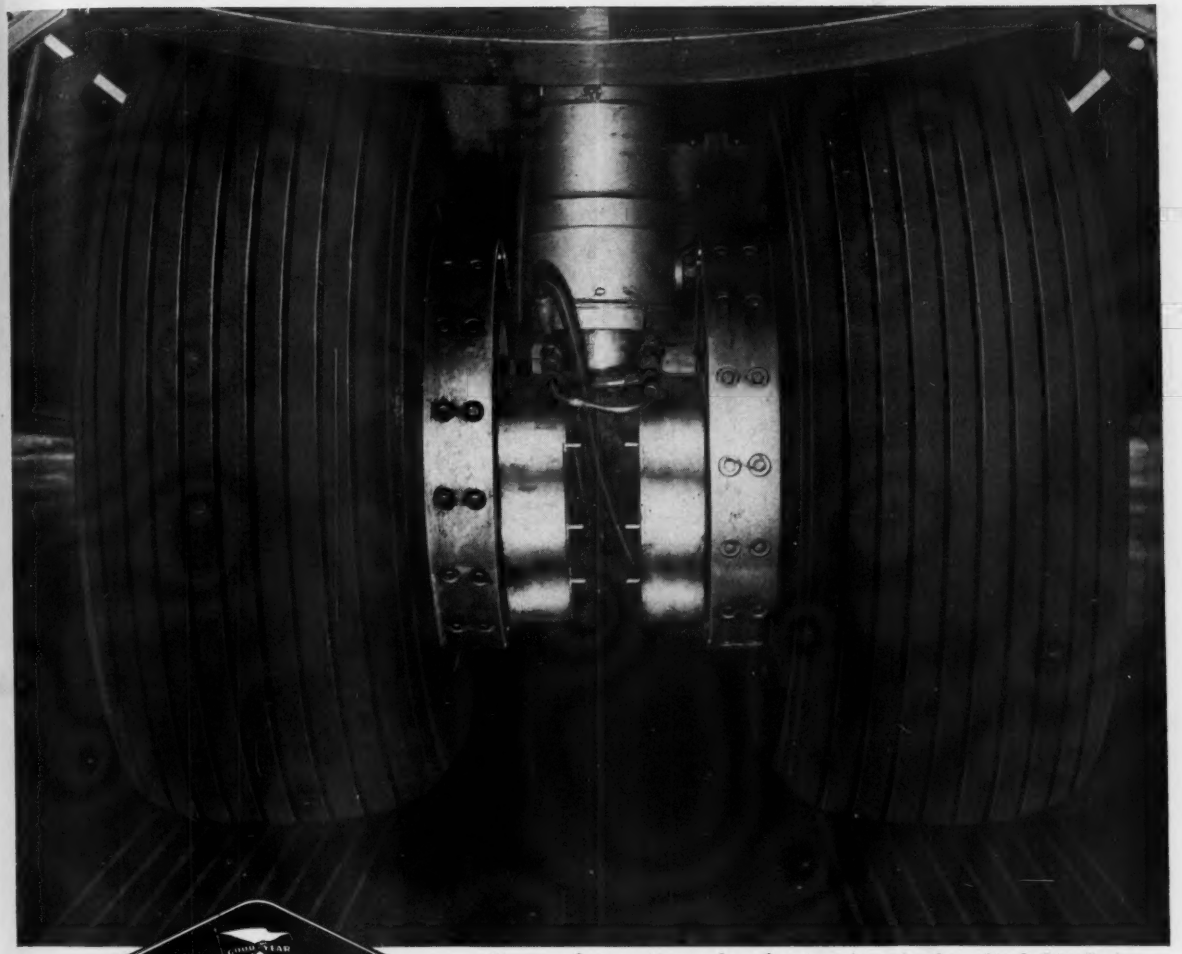
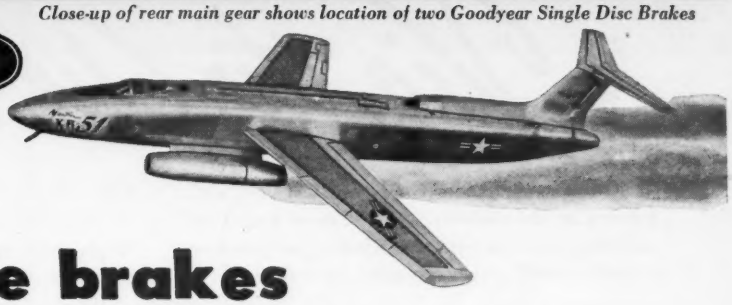




Close-up of rear main gear shows location of two Goodyear Single Disc Brakes

GOODYEAR
AVIATION
PRODUCTS



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for a super-powered jet

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Fairchild C-119 Packets, soon to be flying for the Military Air Transport Service, help fulfill this vital air transportation mission. Capable of carrying 64 passengers or 10 tons of cargo, this twin-engine transport and cargo plane has the *versatility* to accomplish numerous types of operations required via the MATS Air Route.

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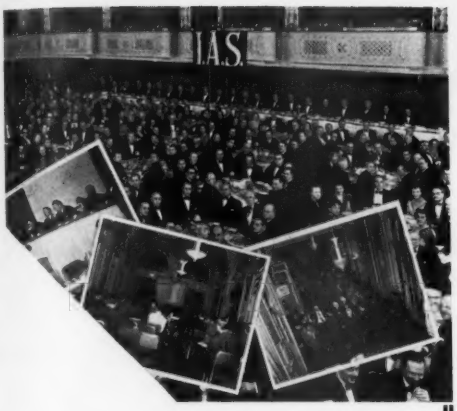

Cover—Scenes from the Eighteenth Annual Meeting and Honors Night Dinner.

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AERONAUTICAL ENGINEERING REVIEW

Vol. 9 MARCH, 1950 No. 3

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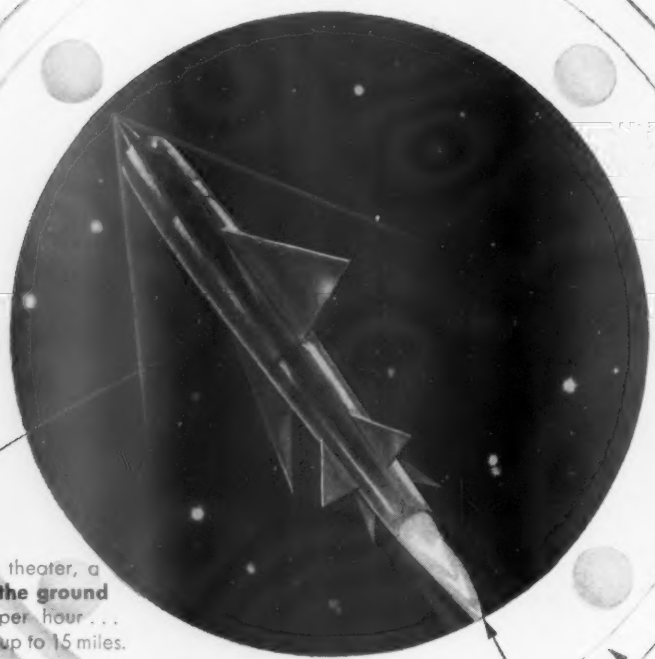

Ram Jet Rehearsal...at Mach 4

In this new Wright Aeronautical 96-foot steel theater, a ram jet engine is the featured performer. **On the ground** it can simulate speeds up to 2600 miles per hour . . . **four times the speed of sound** . . . altitudes up to 15 miles.

Air compressors and fuel pumps can supply air and fuel at a maximum rate of 140 tons of air, 6,000 gallons of fuel every hour. The engine's tremendous bursts of power are accurately measured by electronic instruments.

Injections of steam . . . up to 150 tons per hour . . . into the exhaust stream decrease pressures at engine's exhaust to simulate the rarefied air at extreme altitudes.

The terrific heat developed . . . up to 4000°F . . . is controlled by water cooling. Three 45-foot silencers muffle the roaring gas and steam jets.

Wright Aeronautical's new ram jet laboratory, largest in the industry and only one capable of testing from sea level to 80,000 feet, was built in cooperation with the U. S. Air Force.

Advanced research and experiment . . . applied to supersonic ram jets . . . is one important phase of Wright Aeronautical's long-range development of **power for air progress.**

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FIRST IN FLIGHT

I.A.S. News

A Record of People and Events of Interest to Institute Members

Annual Business Meeting of the Institute

Reports of President, Treasurer, and Director

The Eighteenth Annual Meeting of the members of the Institute was held at the Hotel Astor, New York, on January 25, 1950. In the absence of President, W. A. M. Burden, C. J. McCarthy, an I.A.S. Vice-President, presided.

Elmer A. Sperry, Jr., Teller, reported that he had received and counted 1,067 valid proxies for voting at the Annual Meeting—a quorum of the voting membership. Preston R. Bassett, Chairman of the Nominating Committee, placed in nomination the following members for election to vacancies on the Council: J. H. Kindelberger, W. A. M. Burden, W. E. Beall, W. K. Ebel, W. Littlewood, E. G. Stout, and Elmer A. Sperry, Jr., for a term of 1 year each; George Brady, William Enyart, Charles Froesch, C. J. McCarthy, and Daniel Sayre, for a term of 3 years each; and the following area councilors for a term of 1 year each: Eastern Area—W. R. Sears and E. S. Thompson; Central Area—H. V. Hawkins and Tom Salter; Western Area—R. L. Bayless and C. P. Steele. On motion duly made, seconded, and carried, they were unanimously elected. The following were nominated and elected in like manner to serve on the Nominating Committee for 1950: Charles H. Colvin, Chairman, Preston R. Bassett, C. C. Furnas, R. Paul Harrington, C. L. Johnson, Clark B. Millikan, Arthur E. Raymond, and Hugh L. Dryden.

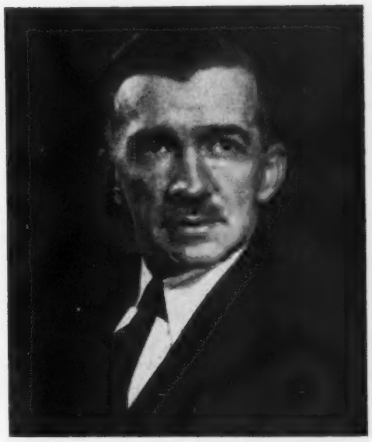
The Annual Reports of the President, Treasurer, and Director were read and approved. (See the following pages for the complete reports.)

The Secretary presented a list of honors conferred by the Institute in 1949 as follows:

The Thurman H. Bane Award to Capt. Harold W. Robbins, Engineering Division, Air Materiel Command; The Octave Chanute Award to Capt. F. M. Trapnell, U.S.N., Coordinator of Tests, Naval Air Training Center, Patuxent, Md.; The John Jeffries Award to Dr. Arnold D. Tuttle, Medical Director, United Air Lines, Inc.; The Robert M. Losey Award to William Lewis, Meteorologist, U.S. Weather Bureau; The Sylvanus Albert Reed Award to George S. Schairer, Staff Engineer, Aerodynamics and Power Plant, Boeing Airplane Company; The Lawrence Sperry Award to Alexander H. Flax, Head, Aeromechanics Department, Cornell Aeronautical Laboratory, Inc.; Special I.A.S. Council Certificate to Jerome Lederer, Director, Flight Safety Foundation; and the Wright Brothers Lecturer, A. E. Russell, Chief Designer, Aircraft Division, The Bristol Aeroplane Company, Ltd., who spoke on "Some Factors Affecting Large Transport Aeroplanes with Turboprop Engines."

Honorary Fellowship in the Institute to: American—Arthur E. Raymond, Vice-President—Engineering, Douglas Aircraft Company, Inc.; Foreign—J. Ackeret, Chief of Institut fur Aerodynamik, Switzerland.

Fellowship in the Institute to: American—George F. Chapline, Vice-President and General Manager, Ranger Aircraft Division, Fairchild Engine and Airplane Corporation, Kenneth S. M. Davidson, Director, Experimental Towing Tank, Stevens Institute of Technology; Rear Adm. T. C. Lonnquest, U.S.N., Deputy Chief, BuAer; Manfred Rauscher, Associate Professor, Aeronautical Engineering, Massachusetts Institute of Technology; Edward R. Sharp, Director, Lewis Flight Propulsion Laboratory, N.A.C.A.; and H. S. Tsien, Robert H. Goddard Professor of Jet Propulsion, California Institute of Technology; Foreign—J. J. Green, Deputy Director General, Defense, Research Board, Canada; Bo Lundberg, Director, Aeronautical Research, Institute of Sweden; and A. E.



P. R. Bassett, Chairman of the Nominating Committee

National Meetings Calendar

March 24	Flight Propulsion Meeting, Cleveland
May 19–20	Personal Aircraft Meeting, Wichita
July 12–14	Annual Summer Meeting, Los Angeles

(For details see page 51)

Russell, Chief Designer, Aircraft Division, The Bristol Aeroplane Company, Ltd.

The Secretary announced that the Council had elected the following officers of the Institute for 1950: President J. H. Kindelberger; Vice-Presidents, W. E. Beall, W. K. Ebel, William Littlewood, and E. G. Stout; Director, S. Paul Johnston; Assistant Director, James L. Straight; Treasurer, Elmer A. Sperry, Jr.; Secretary, Robert R. Dexter; and Controller, Joseph J. Maitan.

ROBERT R. DEXTER, *Secretary*

President's Report

ORGANIZATIONS DO NOT LAST LONG in America unless they do useful work—they do not *grow* unless they are outstanding. The fact that your Institute has increased its membership, expanded the field of its activities, and continued to live within its income are both a tribute to its management and evidence of the fact that it is performing a useful service for our industry and for the young engineers that comprise so large a proportion of our membership.

The Institute could not have made this progress without devoted service and support. Corporations and individual members have done their part. In recent years, some of our most distinguished members and officers have rendered special services far beyond the "call of duty."

Our first great achievement of 1949—the completion of our building program—is an outstanding example of this type of cooperation. Over the last 5 years, a series of presidents, officers, and special committees have labored on the project of providing permanent headquarters for the Institute in Los Angeles and San Diego. The original foundation was laid by Major Fleet and Lester Gardner, who gathered most of the necessary funds in 1944, but it took 5 years of continuous work to translate their vision into brick and mortar.

The buildings were completed and dedicated last August. Many of you have visited them, and I hope all of you will before long. They have been well planned and well executed. The Los Angeles building, in particular, has already become the focal point of technical aeronautical activities in its area.

By providing ideal facilities for technical meetings and agreeable surroundings for social discussions, these facilities will accelerate that free interchange of ideas which is the most important single element in technical progress in a democracy.

Much of the credit for the success of this entire operation goes to our Assistant Director resident in the Western Region. Jim Straight, who is now completing his third year with the Institute, has worked night and day, summer and winter, to get these buildings built and to see that they are used properly and effectively for the purposes for which they were intended.

The next great landmark of the year was the Second International Aeronautical Conference, which was held jointly with The Royal Aeronautical Society of Great Britain in New York last May. Over 50 leading British engineers and scientists and nearly 400 of our own members attended these sessions. A constructive program of technical papers and factory visits was arranged within the security limitations that our benevolent Government imposes just as zealously to save us from indiscretions with our friends as to prevent leaks to our potential enemies. However, I can assure you that anything that may have been lost in completeness of technical presentation was more than made up in effective hospitality, the cementing of old friendships and the creation of new ones.

The two conferences that have been held so far have served to strengthen the bonds between the aeronautical societies of the great English-speaking nations. We look forward with eager anticipation to the next joint meeting, which will be held in London in the fall of 1951.

I am not going to burden you with details of Institute activities for the past year. These will be covered in the Reports of the Treasurer and the Director below. Suffice it to say that the Institute has had a most successful year. Its services and activities have been developed to a higher and higher level through the year. Its membership is on the increase, and its section and branch activities have reached new heights. Furthermore, thanks to the support of its individual and corporate members, its financial position is sound. During fiscal 1949, we operated in the black. The margin was not great, but it was sufficient to offset the small losses that had been incurred in the preceding 2 years. As usual, we are budgeted for a break-even operation for the current fiscal period.

W. A. M. BURDEN, *President*

Treasurer's Report

WHEN A SCIENTIFIC SOCIETY completes a year of service and can show a credit balance on its books, there is little that your Treasurer can say other than let's all keep up the good work.

For the past few years the I.A.S. has had a problem to maintain its services in the face of continuously increasing costs. However, through a fine showing of growing membership, the cooperation of our Corporate Members, and the excellent work of committees, together with an economically minded staff, we have completed the last 3 fiscal years (cumulative) on a break-even basis.

Our balance sheet does not show any significant changes over the preceding years; the investments and cash deposits maintained for the Los Angeles and San Diego building funds are now represented by capital assets consisting of a building in each of those cities.

The condensed operating statement shows that the publications of the Institute produced an income of over $10,000, which, together with the net general income, enabled the I.A.S. to maintain its valuable library services and still show a net gain of $7,555 for the year.

The U.S.A.F. contract to produce a Standard Aeronautical Indexing System was completed in August, 1949. Many of the staff devoted considerable time to this project, and they will now direct their attention to other services of value to members. These will, it is expected, produce some income to offset the loss of benefits derived from the application of the contract overhead against our expenses this year.

The net income of the JOURNAL OF THE AERONAUTICAL SCIENCES is gratifying. This is a result of increasing the subscription price to $12 a year for nonmembers. Members may subscribe to it for only $4.00 per annum. The JOURNAL will show an even better picture next year, since many of the subscribers during 1949 renewed at the old $7.00 rate.

(*Continued on page 9*)

INSTITUTE OF THE AERONAUTICAL SCIENCES, INC.

Statement for the fiscal year October 1, 1948, to September 30, 1949

Consolidated Balance Sheet and Operating Statement

ASSETS

General Fund Assets:		
Cash on Deposit	$ 77,320.18	
Accounts Receivable—Net	12,522.53	
Advance on Contract	8,616.12	
Advances on Intrafund Accounts	19,057.79	
Deposits and Prepayments	8,909.51	
Furniture and Fixtures	5,000.00	
Investments	196,345.60	
Los Angeles Building Operating Fund—Net	5,431.91	
San Diego Building Operating Fund—Net	3,000.00	
Daniel Guggenheim Park (Assessed Value—$454,450.00)	1.00	
Books, Prints, Models, Medals, etc.	1.00	
Aeronautical Index	1.00	
Total General Fund Assets		$336,206.64
Restricted Fund Assets:		
The Thurman H. Bane Award Fund	$ 1,000.00	
The Sherman M. Fairchild Fund	18,332.93	
The Paul Kollsman Fund	69,000.00	
The Vernon Lynch Award Fund	35,767.06	
The Minta Martin Aeronautical Fund	531,422.49	
The Pacific Aeronautical Library Fund	12,041.97	
The Sylvanus A. Reed Award Fund	13,419.03	
The Lawrence Sperry Award Fund	13,183.68	
New York Building, Maintenance and Reserve Fund	324,940.50	
Los Angeles Building and Reserve Fund	399,385.45	
San Diego Building and Reserve Fund	178,120.37	
Total Restricted Fund Assets		$1,596,613.48

LIABILITIES, FUNDS, AND UNEXPENDED INCOME

General Fund:		
Accounts Payable	$ 18,332.11	
Deferred Credits to Income (Dues & Subscriptions)	78,821.25	
Withholding Taxes	1,526.15	
Reserve	150,000.00	
Los Angeles and San Diego Building Funds (intra-fund transactions)	8,431.91	
Unexpended Income:		
Balance September 30, 1949	79,095.22	
Total General Fund Liabilities and Unexpended Income		$336,206.64
Restricted Funds:		
Principal of gifts and unexpended income (See Assets)		
Total Restricted Funds Liabilities		$1,596,613.48

Statement of Income and Expenses

General

INCOME

Dues (less subscriptions)	$142,097.95	
Entrance Fees	3,300.00	
Interest on Investments	7,549.74	
Miscellaneous	450.00	
Excess of Income over Expenses:		
Journal of the Aeronautical Sciences	7,926.33	
Aeronautical Engineering Catalog	5,236.27	
Total Income		$166,560.29

EXPENSES

Administrative and Clerical Salaries	$ 89,421.30	
General Office Expenses—Net	51,073.94	
Excess of Expenses over Income:		
Library Costs	17,924.38	
Aeronautical Engineering Review	585.42	
Total Expenses		$159,005.04
Net Operating Income for the Year Ending September 30, 1949		$7,555.25

Review

INCOME

Advertising Revenue	$ 82,933.72	
Subscriptions	16,774.69	
Total Income		$99,708.41

EXPENSES

Editorial, Advertising, and Clerical Salaries	$ 37,129.63	
Publication and Other Expenses	63,164.20	
Total Expenses		$100,293.83
Excess of Expenses over Income (See General Expenses)		$585.42

Journal

INCOME

Subscriptions	$ 36,051.24	
Reprints	671.37	
Total Income		$36,722.61

EXPENSES

Editorial and Clerical Salaries	5,563.25	
Publication and Other Expenses	23,233.03	
Total Expenses		$28,796.28
Excess of Income over Expenses (See General Income)		$7,926.33

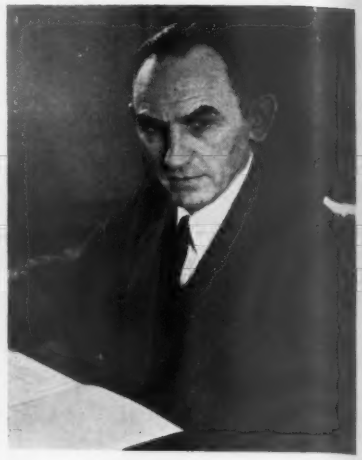
Catalog

INCOME

Advertising Revenue	$ 25,944.67	
Sales and Reprints	146.91	
Total Income		$26,091.58

EXPENSES

Editorial and Advertising Salaries	$ 6,877.86	
Publication and Other Expenses	13,977.45	
Total Expenses		$20,855.31
Excess of Income over Expenses (See General Income)		$5,236.27



I.A.S. Officers for 1950

President
J. H. Kindelberger
Chairman of the Board
North American Aviation, Inc.

Vice-President
Wellwood E. Beall
Vice-President—Engineering Sales
Boeing Airplane Company

Vice-President
William K. Ebel
Vice-President—Engineering
Canadair Limited

Staff Officers for 1950

S. Paul Johnston, Director

James L. Straight, Assistant Director

Robert R. Dexter, Secretary
Joseph J. Maitan, Controller

Vice-President
William Littlewood
Vice-President of Engineering
American Airlines, Inc.

Vice-President
Ernest G. Stout
Assistant to Chief Engineer
Consolidated Vultee Aircraft Corporation

Treasurer
Elmer A. Sperry, Jr.
Vice-President and Treasurer
Sperry Products, Inc.

The net costs of our meetings are progressively increasing as a deliberate program to provide increasing benefits to the membership through broader and more numerous gatherings. The *net* direct costs of meetings and travel expenses is now over $22,000, which does not include salaries of personnel organizing and conducting them.

A balanced budget for the current fiscal year has been adopted, and it is expected that our program of activities will continue undiminished.

Our books were examined by Harris, Kerr, Foster and Company, Certified Public Accountants. An abstract of their certified statement is published in this issue of the Review.

Before closing I want to say that it is my personal opinion that the budget forecasting and the internal administration of the Institute is as good or better than that of most successful businesses.

EARL D. OSBORN, *Treasurer*

Director's Report

AS FORECAST IN MY REPORT a year ago and as indicated in the Treasurer's Report, the operations of the Institute have been conducted in the black during the past year. The 1949–1950 budget is set up on a "break-even" basis.

Meetings

Attendance at all Institute national meetings held during 1949 was excellent, indicating a high degree of interest in the Institute activities. The regular schedule included the Seventeenth Annual Meeting in New York in January, the Fourth Annual Propulsion Meeting in Cleveland in March, the Sixth Annual Personal Plane Meeting in Wichita in April, and the Second Cooperative Meeting with the Soaring Society of America in July. The usual Annual Summer Meeting was held in Los Angeles in July; the Third Annual Military Aeronautics Meeting in Dayton, in October; and the Thirteenth Wright Brothers Lecture, in Washington in December. In addition, the Institute entertained delegates of The Royal Aeronautical Society at the Second International Aeronautical Conference in New York in May.

Membership

Again I am glad to report a general increase in all categories without any drives or campaigns. The Secretary's report on membership, from which the tabulation (right) was taken, indicates the trend. Most interesting is the high rate of transfer from Student to Technical Member, an indication of the great interest in the Institute among younger engineers. Requirements for membership have not slackened in any degree. The Membership Committee is carefully screening all applicants and applications for regrading to maintain the high quality of Institute membership.

Institute section activities continued at a higher rate. Members of the New York staff visited a number of local sections during the year, and every effort is being made to assist them in their work. One section (Columbus) has closed down because of the general exodus of aeronautical people from that area. A new section, organized jointly with The Royal Aeronautical Society and the Engineering Institute of Canada, was established in Ottawa. The table below from the Secretary's record gives the general level of activities of sections and student branches during the year.

Publications

In addition to its regular activities, the Institute's publishing department has been carrying a heavy additional burden during the past few months because of the preparation of the PROCEEDINGS of the Second International Aeronautical Conference and the PROCEEDINGS of the First Convertoplane Congress (held in Philadelphia in December). The report of the Anglo-American Conference is in the form of a book of almost 800 pages. The work of compiling and editing the original papers and of organizing the discussions has been a tremendous job. Credit for its completion goes to Miss Berneice Jarck, Editor of the PROCEEDINGS, and to Welman Shrader, Director of Publications.

The JOURNAL and the REVIEW have been published continuously at the levels and standards set in preceding years. The readership survey of the REVIEW which was mentioned in the report of a year ago was of great help in determining editorial policies and programs during 1949.

The CATALOG was published on schedule. The 1950 edition is now in preparation. The 1949 edition showed a slight margin of income over expense. For 1950 a new editorial policy has been adopted which will improve it and will greatly increase its usefulness. Because of this change, however, a reduction in income for the current year is forecast. It is believed, however, that the change will make the book more acceptable to its users in the future. It is anticipated that by 1951 it should break even again.

The 1949 edition of the I.A.S. Roster was published during 1949. The 1950 edition is now in preparation and will appear in September.

Operations of preprint and reprint departments under the Sherman Fairchild Publication Fund has continued to expand during the fiscal period ending September 30. This activity has distributed to I.A.S. members over 27,170 copies of technical reports under some 135 different titles. Plans are now under way for further expansion to make this of even greater service to Institute members.

Library Services

The Institute's Library services, both East and West, continue to grow. During the year, the Pacific Aeronautical Library moved from its old location

(*Continued on page 16*)

MEMBERSHIP BREAKDOWN—COMPARISONS BY CALENDAR YEAR

	12/31/47	12/31/48	12/31/49
Temporary Honorary Members	18	21	17
Honorary Fellows	21	20	21
Fellows	179	185	184
Associate Fellows	577	600	624
Members	2,781	2,981	3,108
Associate Members	405	416	405
Historical Associate Members	New Grade—January, 1949		56
Technical Members	2,728	2,908	3,449
Total Graded	6,709	7,131	7,864
Student Members	3,300	4,068	3,958
Totals	10,009	11,199	11,822

I.A.S. SECTIONS AND STUDENT BRANCHES

	12/31/46	12/31/47	12/31/48	12/31/49
Number of Sections	13	17	19	19
Number of Section Meetings	72	92	121	126
Number of Members in Sections	4,166	4,734	5,032	5,718
Number of Branches	38	51	60	67
Number of Branch Meetings	210	277	327	336

Newly Elected Members to the Institute Council

Eastern Area

William R. Sears, Director, Graduate School of Aeronautical Engineering, Cornell University

E. S. Thompson, Manager of Sales, Aircraft Gas Turbine Division, General Electric Company

Central Area

Harold V. Hawkins, Professor of Civil Engineering, Illinois Institute of Technology

Tom Salter, Vice-President and Chief Engineer, Cessna Aircraft Company

Western Area

Ralph L. Bayless, Chief, Preliminary Design, Consolidated Vultee Aircraft Corporation

C. P. Steele, Senior Group Engineer, Boeing Airplane Company

Council Members

George W. Brady, Chief Engineer, Propeller Division, Curtiss-Wright Corporation

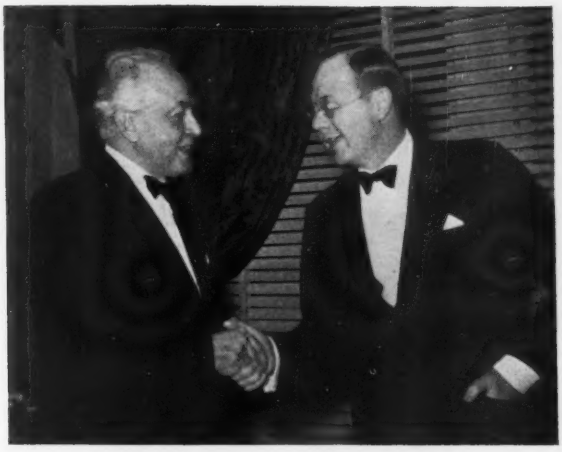
William R. Enyart, President, Simmonds Aerocessories, Inc.

Charles Froesch, Chief Engineer, Eastern Air Lines, Inc.

C. J. McCarthy, Vice-President, United Aircraft Corporation

Daniel C. Sayre, Professor and Chairman, Department of Aeronautics, Princeton University

Honors Night Dinner Highlights



W. A. M. Burden *(right)*, I.A.S. President for 1949, congratulates incoming president for 1950, J. H. ("Dutch") Kindelberger.

GUEST OF HONOR and principal speaker at the annual Honors Night Dinner at the Hotel Astor on Monday evening, January 23, was Walter Lippmann, veteran newspaperman and political analyst, who recently returned from a tour of Europe, the Middle East, and southern Asia. His column, "*Today and Tomorrow*," is published in scores of newspapers throughout North and South America and Australia. Mr. Lippmann, delivering one of his few major public addresses, spoke on "The Balance of Power Today"—or the breakdown of the two-power system in the world and urged a reappraisal of the world strategic situation. He gave his talk before over 1,000 members and guests assembled in the Grand Ballroom of the Hotel Astor.

Disclaiming that he could speak authoritatively and publicly on the subjects scheduled for the Technical Sessions, Mr. Lippmann, in his preliminary remarks, declared that, nevertheless, as a user of air transportation, he had "considerable knowledge and decided views on such subjects as "The Seating Accommodations in the Waiting Rooms of Airports over All Parts of the World" and "The Effect on Passengers of Schedules That Reflect the Fondest Hopes of the Advertising Department."

The text of Walter Lippmann's address will be found on page 30 of this issue.

Five of the 1949 award winners, present at the Honors Night Reception, pose for a group photograph. They are *(left to right)* George S. Schairer, Jerome Lederer, Arnold D. Tuttle, Alexander H. Flax, and William Lewis.

William A. M. Burden, retiring President of the I.A.S., was Chairman of the Dinner. Excerpts from Mr. Burden's opening address are given on the Editorial page (page 29); his report on I.A.S. progress during 1949 is printed on page 6.

▶ **Honorary Fellowships**—Two Honorary Fellowships, one American and one Foreign, were conferred this year. Arthur E. Raymond, Vice-President—Engineering, Douglas Aircraft Company, Inc., was made American Honorary Fellow for 1949. Mr. Raymond was President of the Institute in 1947 and has long been an I.A.S. Fellow. The presentation was made by Mr. Burden. J. Ackeret, Chief of the Institut fur Aerodynamik, E.T.H., Zurich, Switzerland, was made Foreign Honorary Fellow for 1949. Dr. Ackeret was unable to attend the Dinner but cabled his appreciation of the election. Honorary Fellows are elected by the Fellows and Honorary Fellows of the Institute residing in the United States. Not more than one person residing in the United States, or more than one person residing in a foreign country, may be elected as Honorary Fellow in any one year.

▶ **Fellowships**—Nine persons were elected Fellows of the Institute. Fellowships are bestowed on those who have attained a position of distinction in aeronautics and who have made notable and valuable contributions in one of the aeronautical sciences or aeronautical engineering. Named this year were:

- George F. Chapline, Vice-President and General Manager, Ranger Aircraft Engines Division, Fairchild Engine & Airplane Corporation.
- Kenneth S. M. Davidson, Director, Experimental Towing Tank, Stevens Institute of Technology.

(*Continued on page 16*)

I.A.S. Awards and

Arnold D. Tuttle, M.D., Medical Director, United Air Lines, Inc.

The John Jeffries Award

Honoring the memory of Dr. John Jeffries, an American physician who, with Blanchard, the French balloonist, made the first aerial voyage across the English Channel in 1785 and on a previous voyage made the earliest recorded scientific observation from the air, this award was established by the Institute in 1940 to give recognition to the importance to aviation of scientific endeavor in the field of medicine.

Presented to ARNOLD D. TUTTLE, M.D.

"For outstanding contributions to the advancement of aeronautics through medical research."

Prior to his entrance into commercial air transportation, Colonel Tuttle had a long and distinguished career in the Medical Corps of the U.S. Army.

Born in Sturgis, N.D., in 1881, he received his M.D. degree from the University of Maryland School of Medicine in 1906 and was an honor graduate of the Army Medical School in 1909. During World War I he served as a Colonel on General Pershing's GHQ Staff in France, coordinating the evacuation and hospitalization of battle casualties from the front. Upon his return from France in 1919, he served two 4-year tours of duty in the Office of the Surgeon General of the Army at the War Department, Washington, D.C. There he had charge of the organization, planning, and training policies connected with the reorganization of the Army Medical Department, based on his war observation and experience.

It was during this period that Colonel Tuttle began to take an active interest in aviation matters. He was graduated as Flight Surgeon from the U.S. Army School of Aviation Medicine at Randolph Field, Tex., in 1933. In 1934 he was appointed Commandant of the School of Aviation Medicine and served in that capacity until the fall of 1937, when he was

(*Continued on page 17*)

William Lewis, Meteorologist, United States Weather Bureau.

The Robert M. Losey Award

Established in 1940, this award honors the memory of Captain Robert Moffatt Losey, a member of the Institute and a meteorologic officer of the Air Corps, who was killed at Dombas, Norway, April 21, 1940, while serving as an official observer for the U.S. Army. He was the first officer in the service of the United States to die in World War II.

Presented to WILLIAM LEWIS

"In recognition of outstanding contributions to the science of meteorology as applied to aeronautics."

Mr. Lewis, a meteorologist of the U.S. Weather Bureau, was assigned to the Ames Aeronautical Laboratory of the N.A.C.A. from October 1, 1944, to May 6, 1949, for the purpose of carrying out research studies on meteorological conditions conducive to the formation of ice on airplanes. During his period of duty at Ames, N.A.C.A.'s knowledge of the meteorological factors involved in icing conditions progressed from a most elementary state to its present position, which permits a rational approach to the design of ice-prevention equipment.

Mr. Lewis's collaboration was of the utmost importance in this advance. He was relied upon for all technical decisions relating to the meteorological phase of the research. This included choice of meteorological parameters to be evaluated, advice on the design of suitable measuring instruments and their improvement through operational experience in flight, choice of daily flight plan to assure encounters with the desired variety of meteorological conditions, and analysis of the data and their reduction to a form that would be usable for engineering purposes.

(*Continued on page 17*)

Honors for 1949

George S. Schairer, Staff Engr., Aerodynamics and Power Plant, Boeing Airplane Company

The Sylvanus Albert Reed Award

For a notable contribution to the aeronautical sciences resulting from experimental or theoretical investigations, the beneficial influence of which on the development of aeronautics is apparent.

The late Dr. S. A. Reed, designer of metal aircraft propellers and a Founder Member of the Institute, made an endowment to the Institute in 1933 to provide an annual award with a certificate and honorarium of $250. The recipient of this award is chosen by ballot of the American Honorary Fellows and Fellows of the Institute, who now number more than 160 of this country's leading aeronautical scientists.

Presented to GEORGE S. SCHAIRER

"For his analytical and experimental work contributing to the design and development of large swept-wing high-speed aircraft."

As Staff Engineer, Aerodynamics and Power Plant, Boeing Airplane Company, Mr. Schairer had large responsibilities for the aerodynamic research and development in connection with the design of the B-47 swept-wing jet bomber. Considered one of the leading aerodynamicists in this country, he joined the engineering staff of Boeing in Seattle in June, 1939, starting in aerodynamics. He was active in aerodynamic design work of the B-17E, B-29, B-50, and C-97, in addition to the B-47, all of which added luster to the name of Boeing.

Born in Wilkinsburg, Pa., May 19, 1913, Mr. Schairer received his B.S. in general engineering from Swarthmore College in 1934, and his M.S. in aeronautical engineering from Massachusetts Institute of Technology a year later, having completed the degree with distinction, specializing in the mechanics and engineering of autogiros.

(*Continued on page 17*)

Alexander H. Flax, Head, Aeromechanics Dept., Cornell Aeronautical Laboratory, Inc.

The Lawrence Sperry Award

For a notable contribution made by a young man to the advancement of aeronautics.

This award was endowed in 1936 by the sister and brothers of the late Lawrence Sperry, pioneer aviator and inventor, who died in 1923 at the age of 31. It provides an annual certificate of citation and honorarium of $250 to the recipient selected by the Board of Award.

Presented to ALEXANDER H. FLAX

"For significant additions to the methods available for determining dynamic behavior of airplanes, helicopters, and missiles."

Alexander Flax, who was 29 last January 18, was born in Brooklyn, N.Y. He received his B.Ae.E. in 1940 from New York University, Guggenheim School of Aeronautics, and was employed as a Stress Analyst with Curtiss-Wright Corporation in Buffalo, N.Y. Later he was transferred to structural development and flutter work, being head of a unit comprising flutter and vibration, structural methods, and structural flight test groups at time of his resignation in 1944 to become Chief of Aerodynamics and Structures for Piasecki Helicopter Corporation.

In 1946 he left Piasecki and was appointed Assistant Head, Aeromechanics Department, Cornell Aeronautical Laboratory, Inc. Three years later he was made Head of the Department, and he still holds this position.

At Cornell, Mr. Flax has been responsible for research in airplane and helicopter dynamics, aeroelasticity, flutter, missile guidance, etc. Recently, his assignments have been expanded to include such items as boundary-layer research;

(*Continued on page 17*)

1949 I.A.S. Fellows

American Fellows

George F. Chapline, Vice-President and General Manager, Ranger Aircraft Engines Division, Fairchild Engine & Airplane Corporation

Kenneth S. M. Davidson, Director Experimental Towing Tank, Stevens Institute of Technology

T. C. Lonnquest, Rear Admiral, U.S.N., Deputy Chief, Bureau of Aeronautics, Navy Department

Official U.S. Navy Photograph

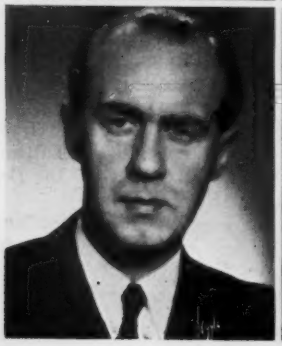
Manfred Rauscher, Associate Professor of Aeronautical Engineering, Massachusetts Institute of Technology

Edward R. Sharp, Director, Lewis Flight Propulsion Laboratory, N.A.C.A.

H. S. Tsien, Robert H. Goddard Professor of Jet Propulsion, California Institute of Technology

Foreign Fellows

J. J. Green, Deputy Director General, Defense Research Board, Canada



Bo Lundberg, Director, Aeronautical Research, Institute of Sweden

A. E. Russell, Chief Designer, Aircraft Division, The Bristol Aeroplane Company, Ltd.

Jerome Lederer Honored by I.A.S.

Special I.A.S. Council Certificate

Presented to
JEROME LEDERER
Director
Flight Safety Foundation

"For his outstanding contributions in engineering for flight safety and for his untiring efforts to encourage research in this field."

A Special I.A.S. Council Certificate was presented to Jerome Lederer for his outstanding contributions to safety in the air at the Annual Honors Night Dinner, January 23, at the Hotel Astor.

As Director of the Flight Safety Foundation, a nonprofit independent organization, Mr. Lederer has spearheaded a concerted attack on problems connected with safety in flight. He summed up the objective of the air transport industry to be: "No fatal accidents; perfection must be our goal," for, he added, "marvelous air safety statistics must be ignored because the public, being mentally conditioned to fear flying, is not impressed by them."

▶ **Eminent Reputation**—A practicing aeronautical engineer for more than 25 years, Mr. Lederer has earned an eminent reputation in the safety engineering field, both in Government service and in private firms.

Born in New York City in 1902, he received his degrees at New York University and was awarded the David Orr prize for excellence in professional subjects. The university appointed him Assistant in the Department of Aeronautics, in charge of wind-tunnel erection and calibration, 1924–1925, and the following 2 years he served as Aeronautical Engineer in the U.S. Mail Service.

In 1929 he was named Chief Engineer, Aero Insurance Underwriters and, as a result of his work in that capacity, was appointed Director of Safety Bureau, Civil Aeronautics Board, 1940–1942. He was then made Executive Assistant and Director of Training, Airlines War Training Institute. On completion of this project, Mr. Lederer was called upon to be Consulting Operations Analyst for the U.S. Army Air Forces and at war's end was acquired by the U.S. Strategic Bombing Survey as Bombing Research Analyst.

He now is, in addition to his duties with Flight Safety, Technical Adviser to U.S. Aviation Underwriters, Inc.

I.A.S. General News

Supersonic Speeds by Practical Military Planes Now Possible, Hunsaker Report Says

Flight at supersonic speeds by practical military aircraft is possible for any nation willing to make the effort, according to Dr. J. C. Hunsaker, H.F.I.A.S., Chairman of the National Advisory Committee for Aeronautics, in the 35th annual report of the N.A.C.A.

▶ **Long Range Poses Problem**—However, the attainment of long range at supersonic speeds poses a most difficult problem, the report noted.

The N.A.C.A.'s report represents a detailed summary of such of its fiscal 1949 research efforts as are not classified. It includes not only work accomplished at the three principal N.A.C.A. laboratories in Virginia, California, and Ohio but sponsored research programs conducted at a large number of scientific and educational institutions.

Gains in the continuing race for air leadership were made by the U.S., the report states, "through the coordinated effort of scientists and engineers throughout the country—notably in the aircraft industry, the military establishment, and N.A.C.A.—supported by the work of educational institutions and other research agencies. The same teamwork is required to consolidate these gains and to push forward."

▶ **Unitary Plan**—Congress, Dr. Hunsaker observes, wisely provided for increasing the effectiveness of this team by its authorization of the Unitary Wind Tunnel Plan for establishment of needed facilities for transonic and supersonic research, development, and evaluation. The Unitary Plan represents an extension of the teamwork idea initiated by the cooperative military-industry-N.A.C.A. research-airplane program that led to the achievement of supersonic flight.

In that program, forces were joined to produce research results. In the Unitary Plan, the same forces will be joined to expedite the development and sound evaluation of practical aircraft capable of superior performance required to meet an emergency, the report declared.

▶ **Designers Apply New Data**—High point in the nation's 1949 aeronautical research year was "the eagerness of aircraft designers to apply the new knowledge being obtained from N.A.C.A.'s high-speed research program. Great efforts are being made by Air Force and Navy in fostering the design of operational transonic and supersonic aircraft," Dr. Hunsaker noted.

For the first time in peacetime history, he added, organized research effort has been unable to stockpile scientific knowledge for future use. Demand is for advanced scientific knowledge for immediate application.

I.A.S. Members Participate in Air Force Program to Develop Air Safety Data

Two Northrop Aircraft engineers, Edward C. Denzin, M.I.A.S., Project Engineer, and George E. Nichols, M.I.A.S., Test Engineer, have participated in the design, construction, and technical operation of the spectacular air-crew deceleration facility used in experiments being conducted at Edwards Air Force Base, Muroc, Calif.

▶ **Rocket Sled**—Ed Denzin directed the Northrop phases of the project from its inception, while a crew of Northrop technicians, under the supervision of George Nichols, maintains and operates the rocket-propelled sled under Air Force direction.

(*Continued on page 18*)

Director's Report

(*Continued from page 9*)

of 6715 Hollywood Blvd. into the new Institute building in Los Angeles. Its facilities there are equal to any small library in any part of the country. P.A.L. is servicing the western segment of the aircraft industry with current technical abstracts on subscription basis, as well as making current aeronautical literature available to members in its reading room. P.A.L. operates on its own budget and shares its proportion of overhead expense in the Western Headquarters building.

Standard Aeronautical Indexing System

The Institute's contract with the Air Materiel Command for the development of the Standard Aeronautical Indexing System expired on August 15, 1949. During the Spring and early Summer, continuous effort was made to develop a new program to permit the continuation of the activity. Proposals were submitted through the ONR in Washington, as well as to U.S.A.F. Air Materiel Command, but, largely because of uncertainties in A.F. and Navy budget, no new contract was developed. It was necessary, therefore, to disband the S.A.I.S. group and make appropriate adjustments in the Institute budget to offset the reduction in operating expense which had resulted from overhead items allowed under the contract.

Aeronautical Archives

During 1949, a limited activity authorized by the Council was carried out. The effort made to obtain new members in the Historical Associate category met with only limited success. A full report was presented to the President, as Chairman of the Archives Committee. As directed by the Council, this effort will be continued on a reduced scale during the current year.

During 1949, the Institute Museum at 2 East 64th St. was completely rearranged and a complete cataloging of all items on hand undertaken. Four issues of the small bulletin AERONAUTICA were published during the year.

West Coast Building Program

The new building at Los Angeles, completed just in time for the 1949 Annual Summer Meeting, has already demonstrated that it was seriously needed by the technical and scientific fraternity of the area.

It has provided a most convenient home for the Institute membership and library activity, for the Aircraft Industries Association and its many dozens of committee meetings, and for the Los Angeles offices of the National Advisory Committee for Aeronautics. It has proved itself thoroughly as an ideal, specially equipped meeting place devoted exclusively to the practitioners of the many sciences and technologies that contribute to aviation.

The Los Angeles building was completed within the limits of the capital funds available. Present indications are that its first year of operation will be on a "break-even" basis, and there is every reason to believe that it will continue to be self supporting.

The situation at San Diego is less reassuring. The building was completed with the available capital funds, but it has been operating at a loss. This is due largely to inability to rent to suitable tenants the available office space originally counted on to balance its maintenance and operating budget. The local management committee is struggling with the problem, with the support of a small fund allocated to the activity by the Council. It is hoped that some solution in the maintenance problem will be found during the current fiscal year.

General

The change in organization recommended last year has been put into effect and has been working well. James L. Straight was appointed Assistant Director of the Institute and has been put in charge of all activities on the West Coast. Mr. Straight has done an excellent job in supervising the completion of the western buildings and putting both into commission. As resident executive officer of the Institute, he has strengthened all Institute activities in the western region during the past year.

In closing I want to extend my personal thanks to the Institute staff. Whatever measure of success has come during the past few years has been directly from the hard work and intelligent cooperation of every member of this organization. I want to extend my personal thanks for the job that has been done to make the Institute of maximum usefulness to its membership.

S. PAUL JOHNSTON, *Director*

Honors Night Dinner Highlights

(*Continued from page 11*)

- J. J. Green, Deputy Director General, Defense, Research Board, Canada.
- T. C. Lonnquest, Rear Admiral, U.S.N., Deputy Chief, Bureau of Aeronautics.
- Bo Lundberg, Director, Aeronautical Research Institute of Sweden.
- Manfred Rauscher, Associate Professor, Aeronautical Engineering, Massachusetts Institute of Technology.
- A. E. Russell, Chief Designer, Aircraft Division, The Bristol Aeroplane Company, Ltd., England.
- Edward R. Sharp, Director, Lewis Flight Propulsion Laboratory, National Advisory Committee for Aeronautics.
- H. S. Tsien, Robert H. Goddard Professor of Jet Propulsion, California Institute of Technology.

▶ **Annual Awards**—Four awards were presented by Mr. Burden (see pages 12–13 for citations and recipients' biographies): The John Jeffries Award, to Arnold D. Tuttle, M.D., Medical Director, United Air Lines, Inc.; The Robert M. Losey Award, to William Lewis, Meteorologist, U.S. Weather Bureau; The Sylvanus Albert Reed Award, to George S. Schairer, Staff Engineer, Aerodynamics and Power Plant, Boeing Airplane Company; and The Lawrence Sperry Award, to Alexander H. Flax, Head, Aeromechanics Department, Cornell Laboratory.

▶ **Safety in Flight**—Believing that proper recognition of notable service to the safety aspects of aeronautics could not be given through one of its standing awards, the I.A.S., for the first time, awarded a Special I.A.S. Council Certificate to Jerome Lederer, Director of the Flight Safety Foundation (see page 15).

▶ **New President**—As his final official act I.A.S. President William A. M. Burden introduced James H. ("Dutch") Kindelberger, who took over the Presidency of the I.A.S. for 1950. "Dutch" Kindelberger is Chairman of the Board and Chief Executive Officer of North American Aviation, Inc.

"When a new skipper takes over a ship that has been well handled, has a good crew, and has been kept in fine shape, he has a much easier job to do," Mr. Kindelberger remarked in a brief address. "I hope that the Institute will continue to go forward next year as it has in the past."

The John Jeffries Award

(*Continued from page 12*)

retired from the Army on his own application. He was immediately appointed Medical Director of United Air Lines, Inc., with headquarters in Chicago, a position he has held continuously since.

As Medical Director of United Air Lines, Colonel Tuttle pioneered in organizing an air-line medical department and in applying research in military aviation medicine to commercial aviation principles and practices.

Among his writings are the Army's *Handbook for the Medical Soldier*, and numerous articles in medical and technical journals. He is a member of the Institute of the Aeronautical Sciences (MEMBER), the American College of Surgeons (Fellow), American Medical Association (Fellow), Association of Industrial Physicians and Surgeons, and Association of Military Surgeons of the United States. He also was co-founder and first President of the Airlines Medical Directors Association and currently is President-elect of the Aero Medical Association, of which he is a Fellow.

Colonel Tuttle's military decorations include the U.S. Distinguished Service Medal, French Legion of Honor, and Belgian Order of Leopold. In recognition of his World War I service, his name was placed on the Army's Initial General Staff Corps Eligible List, established by a special act of Congress.

The Robert M. Losey Award

(*Continued from page 12*)

In carrying out his research studies at Ames, Mr. Lewis participated in a great many flights in icing conditions over a large portion of the U.S. Frequently, these conditions were severe, and a large number of the flights were made in the Pacific-Northwest region, where the mountainous terrain produced large cumuli which he wished to examine but also provided an extremely hazardous area in which deliberately to seek icing conditions.

In his analysis of the data, Mr. Lewis examined the fundamental factors of liquid-water content, drop size, and free air temperature in terms of the various cloud types and meteorological processes by which these types were formed. He succeeded to a remarkable extent in his objective to obtain a better understanding of cloud structure and manner of formation so that, in the future, basic parameters for various cloud types could be predicted and icing conditions of maximum intensity and duration could be specified. As a result of his reports, the airplane designer and operator are now in a much better position to know, quantitatively, the icing conditions to which a plane will be subjected in normal operation.

Mr. Lewis was born in Los Angeles, Calif., November 25, 1909, and was educated at University of California (L.A.), receiving his A.B. in 1933 and M.A. in 1943.

The Sylvanus Albert Reed Award

(*Continued from page 13*)

In the summer of 1935, he joined Bendix Products Corporation, South Bend, Ind., where he was engaged in design work, mostly of a preliminary nature, on small aircraft and autogiros. In 1937, Mr. Schairer left Bendix to join Consolidated Aircraft Corporation (now Consolidated Vultee Aircraft Corporation), San Diego, Calif., where he did some structural work and conducted all wind-tunnel investigations for $1^1/_2$ years. He also was responsible for the major layout work on flaps for the B-24 Liberator.

He was a member of the U.S. Air Force Scientific Advisory Group from November, 1945, to September, 1946 and, since January, 1946, has been a member of the Aerodynamics Committee of the National Advisory Committee for Aeronautics. In January, 1948, he was made Chairman of the Subcommittee on Propellers for Aircraft, N.A.C.A.

An Associate Fellow of the Institute of the Aeronautical Sciences, Mr. Schairer served as Chairman of the Seattle Section in 1947 and was a Member of the I.A.S. Council in 1948.

The Lawrence Sperry Award

(*Continued from page 13*)

experimental aerodynamics, including heat transfer studies; missile stability; propulsion and combustion studies and experiments; trans- and supersonic aerodynamic theory; and supersonic wind-tunnel operation and design.

The results of his work, both analytical and experimental, on airplane and helicopter flutter, aeroelasticity and divergence, helicopter and missile stability and control, and rotor blade stresses not only have provided a variety of pertinent data and analytical methods for the use of aeronautical engineers but have enabled the reduction to successful practice of the unusual configurations of Piasecki helicopters.

More recently, the results of his research have been instrumental in establishing the supersonic flutter and stability control characteristics of a family of Navy guided missiles.

Among his many contributions to the advancement of aeronautics are several methods of solution of the equations that govern helicopter blade bending, including an extension of the Stuart-Myklestad method of propeller blade stress analysis and contributions to the experimental determination of the oscillating airfoil coefficients in the $V/b\omega$ region 0.5 to 3.5. Particularly important were the aileron lift and moment, tab lift and moment, and their interaction.

Last Chance for Roster Listing

In order that the 1950–1951 *I.A.S. Roster of Members* be as complete and accurate as possible, a last call is being issued for latest data concerning present employment and titles, company addresses, and preferred mailing addresses of I.A.S. members.

This is your last opportunity to be correctly listed in the 1950–1951 *I.A.S. Roster*. Some members have failed to send in their completed roster cards, and for this reason we have extended the original deadline date to MARCH 30, 1950, after which no further returns can be accepted. Make sure that the roster card previously mailed to you for completion is filed before that date.

I.A.S. General News

(*Continued from page 15*)

Tests conducted with the device, known as an air-crew decelerator, already have given aeromedical science a heretofore unobtainable "stress analysis" of the human body, providing accurate data on just how much of the terrific decelerative force encountered in a crash the human body can withstand.

▶ **Deceleration of 35*g***—In the Air Force experiments, volunteers ride the decelerator sled, which is propelled along a railway track by solid fuel rockets, into a series of mechanical brakes. The brakes decelerate the sled with a force equivalent to that experienced in actual crash landings.

The U.S.A.F. volunteers have completed a series of decelerative tests in gradual increases up to 35*g*, while facing in both forward and backward positions. In a backward-facing position, the seat back provides the support, while with forward-facing seats, it is necessary to provide volunteers with special seat harness consisting of web straps fastened across the lap, round each thigh, and over each shoulder to enable them to withstand the high *g* forces.

▶ **Weighs 1,500 Lbs.**—The air-crew decelerator is a carriage mounted on metal slides, or "clippers," in lieu of wheels. Carriage weight is 1,500 lbs. Chassis is of welded tubing construction, stressed for 100*g* with a 50 per cent safety factor. Cab atop carriage chassis is of lightweight construction, intended merely to support occupants and instruments.

The carriage measures 178 by 80 by 74 in.; armor plate braking rails, or blades, are 134 by 5 by 1/2 in.; and the track is 2,000 ft. long. Braking area extends through about 50 ft. Each of 180 brake shoes is 55 sq.in. in area.

The four solid fuel rockets, each capable of delivering 5,000 lb.-sec. of thrust within accurate limits, power the carriage.

▶ **Braking Method**—Braking is accomplished by 45 mechanisms, each consisting of two pairs of clasp-type brakes, installed on the road bed beginning at a point 1,250 ft. from starting end of the track.

Brakes clasp braking rails attached beneath chassis of the carriage to apply desired amount of retarding force and are actuated hydraulically, each shoe capable of exerting a pressure of 33,000 lbs. The 45 sets of brakes may be controlled individually, and an emergency braking system is installed near the extreme end of the track.

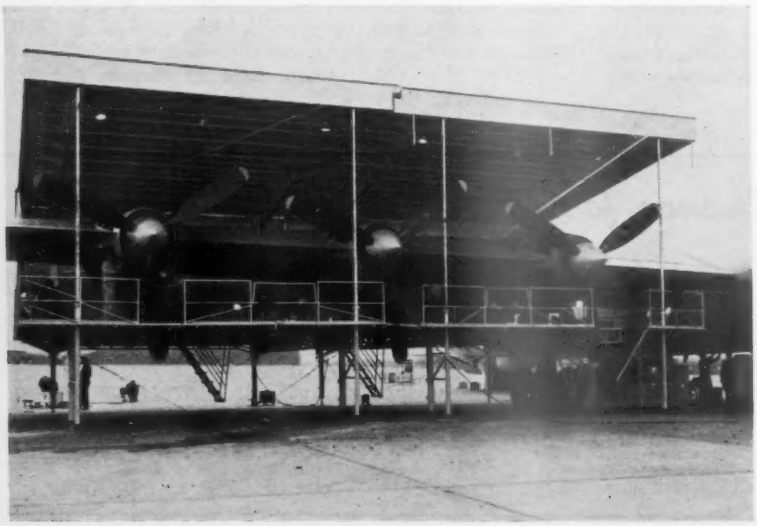
▶ **Instruments**—Northrop electronics experts devised a means of transmitting information during the brief period of the test in the form of a miniature radio transmitter capable of sending four simultaneous signals and mounted in a special cushioning element that enables it to function even while subjected to enormous shock as the carriage enters the brakes.

Four accelerometers are mounted within the carriage attached either to the occupants (volunteers or dummies, it's a question of which is which) or to the chassis. Data from these accelerometers are transmitted through the telemetering equipment to a control tower. Signals generated by stress gages attached to various parts of the volunteers' bodies can be similarly recorded.

Timing of the tests is provided by a Northrop-developed space-time recording system, consisting of coils mounted at 25-ft. intervals along the track, except in the braking area where coils are mounted every foot. A magnet attached to the carriage actuates each coil as it passes over, flashing a series of lights in the control tower.

CONVAIR ALL-WEATHER SERVICE DOCKS FOR B-36

A complete all-weather service dock, consisting of four sections, each 36 ft. in depth and 30 ft. long, has been built by Convair's Fort Worth division for its B-36's. The docks enclose 60 ft. of a B-36 wing on each side of the fuselage, including all engines, allowing workmen to continue operations on the engines and wing despite extremes of cold or heat outside. Wired for compressed air and electricity, docks need only to be connected with external outlets to provide those facilities to the workers. Floodlights are also built in, and mobile heating units will be used with the docks in winter.



Kindelberger Elected by A.I.A.

Aircraft Industries Association has elected James H. Kindelberger, Fellow and 1950 President of the Institute, to the post of Board Chairman, replacing Eugene E. Wilson. In addition, J. S. McDonnell, A.F.I.A.S., President of McDonnell Aircraft Corporation, and La Motte T. Cohu, Convair President, were elected Vice-Presidents, succeeding Kindelberger and Malcolm Ferguson, A.M.I.A.S., President of Bendix Aviation Corporation.

▶ **New Members Added**—Five new members were added to the Board of Governors, including: Richard S. Boutelle, M.I.A.S., President, Fairchild Engine & Airplane Corporation, replacing J. Carlton Ward, Jr., M.I.A.S.; Walter H. Beech, M.I.A.S., President, Beech Aircraft Corporation, replacing C. J. Reese; C. C. Pearson, M.I.A.S., President, The Glenn L. Martin Company, replacing Harry T. Rowland; Roy T. Hurley, President, Curtiss-Wright Corporation, replacing Robert L. Earle; and D. W. R. Morgan, Vice-President, Aviation Gas Turbine Division, Westinghouse Electric Corporation.

Admiral D. C. Ramsey was re-elected President, while Capt. Leland D. Webb, U.S.N. (Ret.), M.I.A.S., and Harrison Brand, Jr., were re-elected Vice-President and Secretary-Treasurer, respectively.

Sixth Annual Helicopter Forum in Philadelphia March 30–31

The Sixth Annual Helicopter Forum, held jointly by the American Helicopter Society and the I.A.S. Philadelphia Section, will be staged at the Ben Franklin Hotel, Philadelphia, March 30–31.

Four individual sessions consisting of helicopter theory, design, opera-

tion, and economics will be discussed at the Forum, covering all phases of the industry.

Chairman of the Forum will be Richard H. Prewitt, A.F.I.A.S., President of Prewitt Aircraft Company; Technical Chairman will be Hugh J. Mulvey, M.I.A.S., Chief of Structures, Piasecki Helicopter Corporation.

I.A.S. Newslines

▸Predictions...Within next 10 years, 6-hour flights across the Atlantic and 4-hour coast-to-coast flights will "probably be a scheduled actuality" as a result of the development of jet propulsion in commercial air transports, **Ralph S. Damon,** F.I.A.S., President of Trans World Airline, believes.

▸On *Aero Digest* Staff...**Dr. Alexander Klemin,** F.I.A.S., has joined *Aero Digest* as Technical Editor.

▸1949 was biggest the U.S. air lines ever had, according to **D. W. Rentzel,** H.M.I.A.S., Administrator of C.A.A. Some 16,500,000 passengers flew a total of 460,000,000 miles. Combined safety rate of U.S. domestic and international air lines was 1.0 passenger fatalities per 100,000,000 passenger-miles flown, lowest in history. On international routes of U.S. lines, no fatalities occurred.

▸Richardson Appointed...Richard S. Boutelle, M.I.A.S., President of Fairchild Engine & Airplane Corporation, has announced appointment of **Lawrence B. Richardson,** F.I.A.S., as Director of Research. Formerly President of the Corporation, Mr. Richardson remained as a Consultant following the change of management last July.

▸McDonnell Engineer...**S. R. Sartore,** A.F.I.A.S., wartime Chief Flight Test Engineer of Curtiss-Wright Corporation, has been named Chief Flight Test Engineer of McDonnell Aircraft Corporation. He recently had been affiliated with McDonnell's Guided Missile Division.

▸Schaefer to Canadair...**Everett B. Schaefer,** A.F.I.A.S., has been appointed Chief Technical Engineer for Canadair Ltd. Veteran of 20 years in aviation engineering, Mr. Schaefer resigned from Boeing Airplane to be in charge of Canadair's preliminary design section and stress, aerodynamic, and weight departments.

▸Power Plants Editor...**Paul H. Wilkinson,** A.F.I.A.S., Editor and Publisher of *Aircraft Engines of the World,* has joined *Aero Digest* as Powerplants Editor.

Corporate Members News

• Ground Heater Order . . . A quantity production order amounting to $3,600,000 for a new ground heater to be used by the Air Force in Arctic operations has been received by **AiResearch Manufacturing Company,** Los Angeles, Calif. Capable of producing 4,000,000 B.t.u. per hour on a −65° day, or enough heat for a 500-room hotel, new development utilizes the new lightweight gas turbine recently developed by AiResearch. Units are said to produce ten times more heat than those in use and will be used to preheat aircraft cabins, engines, and other mechanical equipment and to heat living quarters.

• New A.A. Department . . . Formation of a new **American Airlines** Maintenance & Supply Department, effective last January 1, includes all employees at Tulsa Overhaul Base and employees of the Materials Department and of the Maintenance Division, General Office . . . Robot is answering air passengers wanting information about departure of American Airlines flights, giving flight forecasts just as they now get weather forecasts by telephone. Every 2 hours flight superintendents record specific departure information and a guide to expected conditions beyond that time. Whenever conditions warrant, forecast is changed more frequently . . . American jumped its volume of air freight an estimated 40 per cent to about 32,600,000 ton-miles from 1948's record 23,204,517 . . . 300 alarm clocks shipped by a New England clockmaker to Little Rock, Ark., suddenly pealed forth simultaneously from their boxes to the consternation of American's air-freight agents.

• A.O.A. Expands Strato Service . . . **American Overseas Airlines** has expanded its Boeing Stratocruiser service on the North Atlantic to include Glasgow and Amsterdam. A new 14-hour, 50-min. air service to Scandinavia, combining Stratocruiser and Constellation service, also has been announced by A.O.A.

• Shah Buys Beechcraft Twin . . . Before departing for Teheran, the Shah of Iran selected a shiny new Beechcraft Twin transport plane for his personal use, following an inspection of the U.S. aircraft manufacturing industry, including **Beech Aircraft Corporation.**

• Stratocruiser Deliveries . . . **Boeing Airplane Company** expected to complete delivery of last of a total of 55 air-line Stratocruisers shortly after the first of the year.

• Brown Training School . . . Industrial instrumentation training school scheduled for the first 6 months of 1950 by **Brown Instruments Division,** Minneapolis-Honeywell Regulator Company, includes four short courses of 5 weeks each and one long course of 13 weeks. In addition to the short courses for customers' men (to be held during March, May, and June), intensive courses will be held for specific industries. First course opened January 9; final will end June 30.

• RB-36 Flight Testing . . . The RB-36 reconnaissance plane, newest of the B-36 models, which began extensive flight test-

FIRST PRODUCTION NUMBER

W. G. Lundquist, F.I.A.S. (left), Chief Engineer of Wright Aeronautical Corporation, is shown with the first production engine of the Wright Turbo-Cyclone 18 compound model. With him is T. B. Focke, Vice-President and General Manager of Wright Aeronautical. Just in front of Focke are two of the three exhaust-driven turbines which boost engine's horsepower to 3,250.

ing at Fort Worth Division of **Consolidated Vultee Aircraft Corporation** early in January, will complete first portion of the program before the four jet engines, with which all B-36's are to be equipped, are installed. While its mission is reconnaissance, the RB-36 carries the same defensive armament as the B-36—16 20-mm. cannon. Most of the photo equipment is carried inside the forward bomb bay, equipped with snap-action bomb-bay doors, and includes 14 different cameras—one with 48-in. focal length lens.

• Lockheed's 15th Profitable Year . . 1949 was the 15th profitable year for **Lockheed Aircraft Corporation** since the present company was organized in 1932. Sales for the first three-quarters were $83,000,000 and are estimated for the year to be about $115,000,000. The year also was Lockheed's twelfth of no strikes, a remarkable record of collective bargaining relationship between the company and International Association of Machinists. Employment stood at around 18,000 for the company and its wholly owned subsidiaries.

• DC-6 Production into 1951 Assured . . . **Douglas Aircraft Company, Inc.,** received its third new order for DC-6's and has begun the half-century with assurance of continuous commercial production well into 1951. Latest purchase is for three by Linee Aeree Italiane (L.A.I.) of Italy, which expects to establish service between New York and Rome. Previous orders were given by Compania Mexicana de Aviacion (C.M.A.) (three) and United Air Lines (six), bringing total backlog to 21, including reorders for National Airlines, Sabena, and another five by United.

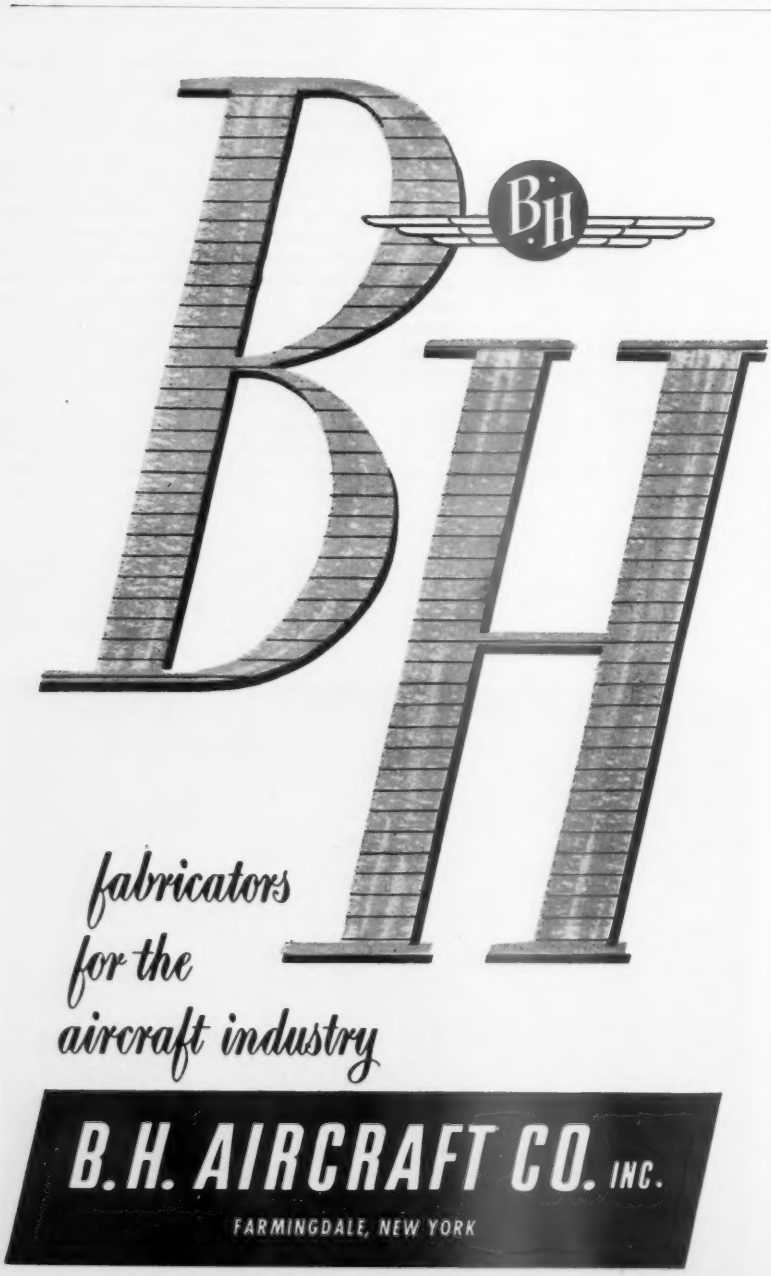
• Rename Pilotless Planes Division . . . **Fairchild Engine & Airplane Corporation** has renamed the Pilotless Planes Division, Farmingdale, L.I., N.Y., the Fairchild Guided Missiles Division.

• G-E Distributor Division Formed . . . Effective last January 1, the Apparatus Agency Division of **General Electric's** Industrial Divisions was replaced by newly organized Agency and Distributor Division . . . The J-47 jet engine, certified recently for commercial jet transport use, has logged several thousand hours of flight time and is the first axial-flow turbojet to be approved by Civil Aeronautics Administration for commercial use. Military rating of the J-47 is 5,200-lb. thrust.

• Goodrich Information Bulletin . . . A new information bulletin on embedded wire resister type of electrically heated rubber has been published by **The B. F. Goodrich Company,** Akron, Ohio.

• Lear Remote Control Receiver . . . Supplementing the well-known Lear VHF Omnimatic system of navigation and other VHF equipment, **Lear, Inc.,** has announced its new remotely controlled VHF receiver with small cockpit tuning control unit available for aircraft owners requiring flexible mounting arrangements. Designated Model LR-5BR, the receiver features continuous tuning for all VHF tower, radio-range, and VOR reception facilities; it weighs 3 lbs. 11 oz. and measures $3^1/_2$ by $6^7/_{16}$ by $10^{27}/_{32}$ in. Diminutive cockpit tuning control unit, Model LR5-CR, may be mounted in any number of easy-to-reach places to suit pilot—weight, 6 oz.; dimensions, $1^7/_8$ by $3^{29}/_{32}$ by $3^{31}/_{32}$ in. Details may be obtained from Lear, Inc., Aircraft Radio Division, 110 Ionia Ave., Grand Rapids 2, Mich.

• Martin Shop Familiarization . . . Savings in basic production costs, both conspicuous and continuous, are accruing these days, according to **The Glenn L. Martin Company,** from Shop Familiarization courses being conducted for the benefit of design engineers and draftsmen as part of the overall program of efficiency and economy. The courses are an outgrowth of Martin's postwar shop training system. Cost-reduction implications behind this activity are readily to be measured by the fact that fully 30 per cent of the fabricated value of an aircraft is normally under the control of the design engineer, William P. Gonce, Supervisor of change-order of Martin's Engineering Department, says. More than a hundred Martin engineers, including supervisors and department heads, in groups of 20, have taken advantage of the courses in which they are brought in direct contact with the shop and its people. Courses cover various standard operations in the shop and nature and purpose of each process involved. Whenever possible, individuals of the groups participate, with little difficulty after an operator's demonstration, in turret-lathe, shearing, milling, welding, explosive riveting, and even

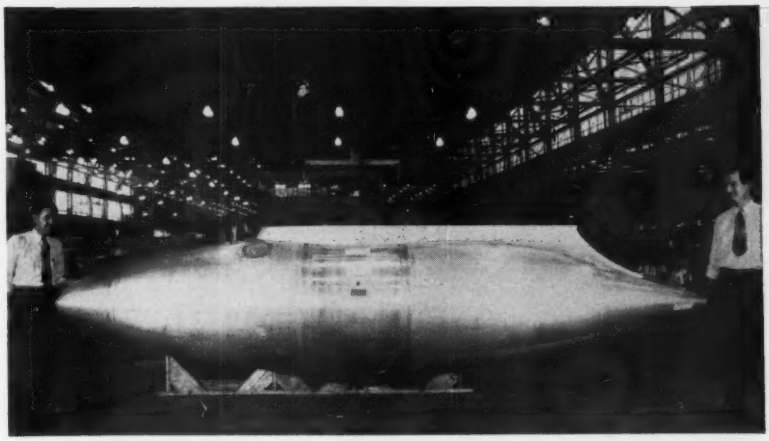


drop-hammer operations. Various aircraft parts are shown them, uneconomical items being contrasted with equivalent parts made from revised designs.

• Honeywell Develops New Valve . . . A nonlubricated cylindrical plug industrial control valve, providing leakproof shut-off while eliminating contamination, has been developed by **Minneapolis-Honeywell Regulator Company.** New design includes a permanent seal at plug stem, sealing packing at base of plug, and a fixed-load spring, combined with a closer dimensional tolerance and microfinish on the plug and body bore. Torque tests are said to show that the cylindrical valve's greatest torque requirement, about 250 in.lbs. at a line pressure of 250 lbs. per sq.in., was equivalent to a force of only $12^1/_2$ lbs. acting on a lever arm 20 in. long.

• Interline Cargo Agreement . . . An interline agreement simplifying the paper work in international air cargo shipments has been worked out by **Pan American World Airways** and Mid-Continent Airlines. Shippers in 31 cities served by Mid-Continent in central U.S. now send their merchandise abroad on a single airwaybill (IATA standard) through Pan-Am's Latin American services at the gateway cities of Houston and New Orleans, reaching any of 64 countries served by the international air line . . . Pan American also has placed into effect a joint one-way fare of $160 and a round-trip fare of $288 between the mainland and all the Hawaiian Islands. Heretofore, this fare applied only between the mainland and Honolulu, with an additional charge for connecting air passage to other islands in the Hawaiian group . . . A self-heating tin can is making flights more enjoyable these days for the men who fly the big cargo Clippers. Cargo aircraft, carrying no stewardesses or galley for serving hot meals aloft, caused round after round of cold sandwiches to become a problem in monotony to crews on long trips. P.A.A.'s commissary department came up with the answer—a can that heats itself after it is punched with a can opener. It is two containers in one (the smaller can of food inside the larger), the space between containing a lime compound. When can is punctured, water drops into the chemical, producing heat, and within 12 min. contents are piping hot. Crews have a choice of such items as chicken chop suey, chicken noodles, frankfurters and beans, egg noodles à la king, chile con carne, beef stew, corned beef hash, etc. Vacuum jugs of coffee and backlog of sandwiches round out the cuisine . . . Pan American Airways Corporation last January was absorbed by Pan American Airways, Inc., and the name of the latter was changed to Pan American World Airways, Incorporated. Company will retain its famous initials carried on wings and tails of the Clippers . . . Actual figures for first 11 months of 1949 and conservative estimate of December's traffic by the Latin American Division show the division's Clippers carried 709,203 revenue passengers a total of 585,960,000 passenger-miles, compared with 683,582 passengers in 1948.

• Lightweight Gate Valve . . . A new, small lightweight gate valve that qualifies for 75 lbs. per sq.in. aircraft fuel system service has been developed by **The Parker Appliance Company,** 17325 Euclid Ave., Cleveland 12, Ohio. New valve also may be supplied for service on high-temperature air; for oil, water-alcohol mixtures; and for other fluids, Parker says. Produced in sizes of $1^1/_4$ in. or $1^1/_2$ in. ($1^3/_4$ lbs.) and 2 in. ($2^3/_8$ lbs.), the valves are made of welded aluminum body halves and utilize line pressure for sealing. Pressure-balanced seal does away with bulky components and minimizes operating friction and wear, according to company. At zero pressure, there is only light spring pressure on the floating seal incorporating a specially compounded fuel-resistant synthetic rubber element molded into a rigid metal container. Whether flow is from either direction, line pressure acts on both sides of the seal, with only sufficient differential to accomplish a positive seal against the gate. Pressure balancing, says Parker, eliminates problems normally encountered in a synthetic seal due to swell, shrink, and cold-flow effects, while minimum seal pressure at same time prevents sticking of seal in closed position. In open position, seal is completely free from the gate, making possible simple dry storage without special attention.



GOODYEAR BUILDS B-50 EXTERNAL FUEL TANK

Closeup view of 700-gal. external fuel tank, production-developed and manufactured by Goodyear Aircraft Corporation, for the Boeing B-50D Superfortresses. Goodyear also makes nose assemblies of metal and Plexiglas for the B-50D in its plastics department.

• Two Awards to Pratt & Whitney . . . Two record certificates of award of the Federation Aéronautique Internationale were presented to **Pratt & Whitney Aircraft Division,** United Aircraft Corporation, at the National Annual Aviation Forum in Washington, D.C. The division was honored for the design and manufacture of the R-2800 Double Wasps and R-4360 Wasp Major engines utilized in establishing a U.S. intercity speed record between Chicago and Miami and between San Francisco and Washington, D.C.

• Ryan Shows Profit . . . 1949 was 17th profitable year for **The Ryan Aeronautical Company** since its incorporation in 1931. Sales for the year were $15,268,087, largest volume of any postwar year. Net profit after taxes was $346,674, approximately the same as for 1948.

• United Orders Six More DC-6B's . . . An order for six new Douglas DC-6B transport planes has been placed by **United Air Lines, Inc.** The DC-6B's will be in addition to five new DC-6's ordered last year and will bring the company's fleet of this type transport to 50. The six newly ordered planes will cost $900,000 each as against approximately $866,000 being paid for each of the five DC-6's previously ordered, deliveries of which are scheduled to start this month. Delivery of the DC-6B is expected to start early in 1951.

Changes of Address

Since the Post Office Department does not as a rule forward magazines to forwarding addresses, it is important that the Institute be notified of changes in address 30 days in advance of publishing date to ensure receipt of every issue of the *Journal* and *Review*.

Notices should be sent directly to the Institute of the Aeronautical Sciences, 2 East 64th Street, New York 21, N.Y.

Meet Your Section Chairmen

Everard M. Lester

New York Section

Now Director of Engineering, Ranger Engines Division, Fairchild Engine & Airplane Corp., Everard Mason Lester first became interested in aviation in 1926. A pilot with some 2,000 hours in his logbook, flying and aerodynamics have remained absorbing subjects to him, but his strongest interest has always been in power plants for propulsion purposes.

In his work with Ranger, he is responsible for all phases of engineering, including design, development, and research technical work, as well as administration of engineering operations. He has been with Ranger since 1941.

Prior to his joining Ranger, he was employed by Pratt & Whitney Aircraft, Hartford, in engineering and sales positions.

In addition to work in design, development, and production of conventional and special types of turbine and reciprocating engines for vehicle propulsion purposes, he has been actively engaged in the design and development of engine test facilities for both Government and industrial use.

▶ **M.I.T. Graduate**—Born in Norwich, Conn., 43 years ago, Mr. Lester has the degrees B.S., M.E., and M.S. in business administration at Massachusetts Institute of Technology and also earned his wings from Air Corps flying schools in July, 1929. At M.I.T. he received the Charles Hayden Fellowship in business administration in 1932.

He has flown all military single- and twin-engined types up to 1941 and was a member of the Connecticut National Guard, Air Corps, from 1930–1940.

▶ **Articles Written**—Mr. Lester is the author of a paper, "Performance Characteristics of an Aircraft Engine with Exhaust Turbine Supercharger," published by the National Advisory Committee for Aeronautics in May, 1941. He also wrote "An Evolution of Engine Types" for the March, 1943, issue of *Aero Digest*.

Married and the father of two children, Mr. Lester enjoys flying and amateur motion pictures for relaxation.

Alfred L. Wolf

Philadelphia Section

Back in 1929, 2 years after Lindbergh's solo skip to Paris, Alfred Wolf returned home from Oxford University filled not only with the jurisprudence gained from study in that learned institution but also with a profound conviction that flying was here to stay.

Never one to permit a dynamic idea to knock around without appropriate action, Mr. Wolf, deciding that the two professions—flying and the law—were not necessarily incompatible, took lessons in piloting. However, although he has logged some 3,570 hours in the air flying all types of planes, including "whirligigs," his legalistic sense forbids anything more than the raising of questioning eyebrows to the query of whether he is a pilot.

▶ **Aviation Clientele**—A partner of the law firm of Wolf, Block, Schorr and Solis-Cohen for the past 20 years, Mr. Wolf represents the aviation clientele of this large company of "Philadelphia lawyers."

In his free time he commands the 327th Troop Carrier Squadron, U.S. Air Force Reserve, having been a pilot and operations officer in the Air Transport Command, Army Air Forces, for 3 years in the Pacific during the war.

Some of Mr. Wolf's background can be summed up briefly:

- Born in Atlantic City, N.J., in 1904, Mr. Wolf was graduated from Princeton in 1924, and Oxford (Juris) in 1926.
- Pilot and aircraft owner since 1929, he was named Director, Aviation Department, City of Philadelphia, from 1936–1938, "when I resigned before being thrown out."
- Legal Examiner for the Civil Aeronautics Board from 1939—"disciplining my fellow fliers."
- Secretary and General Counsel of the Aircraft Owners & Pilots Association since organization of that body.
- U.S. Delegate, Fedération Aéronautique Internationale, in Paris, September, 1948, and member of the Tourisme Committee.
- Chairman of the Aviation Law Committee of the Pennsylvania Bar Association since 1933, in which capacity he has "enjoyed ridding the books of hampering and unnecessary aviation legislation."

▶ **Publications**—Among Mr. Wolf's technical publications are: "Courts Now Deem Airports Necessary," in the *Journal of Air Law and Commerce;* "The Unwary Airshippers' Peril," in the *Pennsylvania Bar Association Quarterly;* and "Legally Speaking," a column contributed to the AOPA Section, *Flying* magazine.

In addition, he has given a paper, "What Private Flying Needs from You," before the I.A.S. Philadelphia Section.

An inventor, Mr. Wolf claims to have developed a "magic means of dislodging Hartzell props from Warner crankshafts in midair, applied at 4,000 ft., for the purpose of making unheralded visits to little-known islands of the Gulf of Mexico."

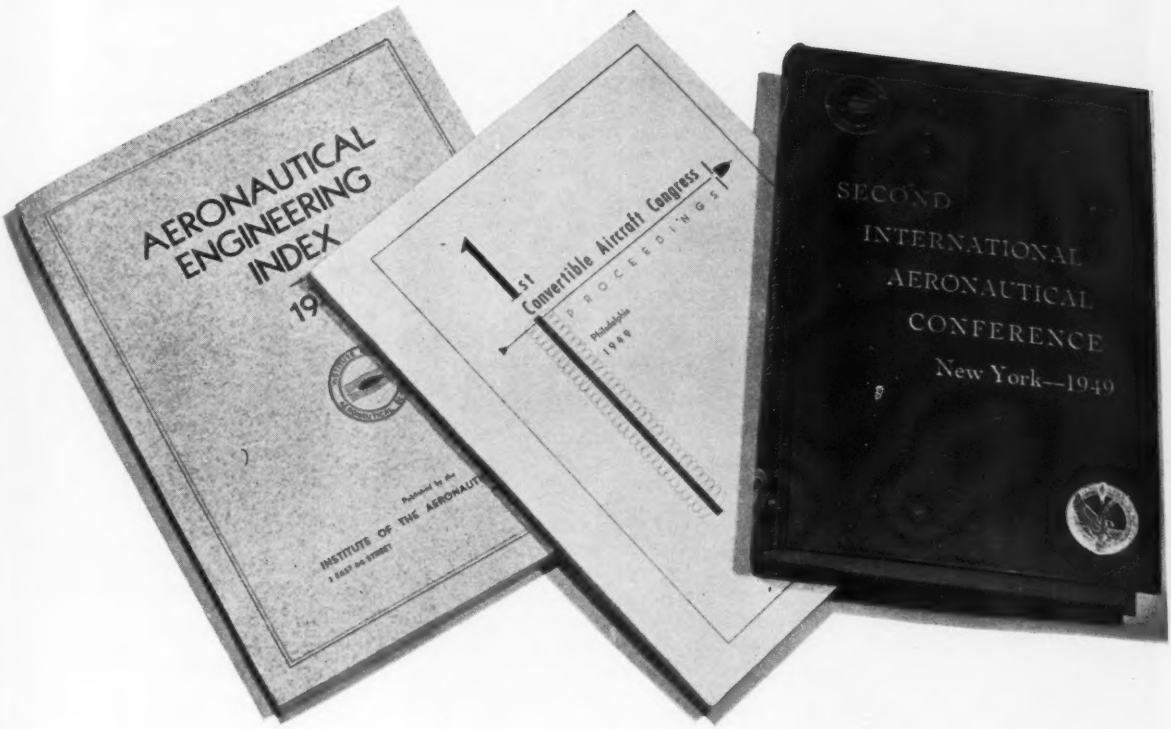
▶ **Relaxing**—His favorite means of relaxation, soberly remarks the flying lawyer, is " 'sleep' induced by listening to highly technical preprepared papers, and drink," the latter not being specified.

Mr. Wolf also amuses himself by "underwater fish chasing, variously termed 'goggling,' 'skin fishing,' etc."

However, his great enjoyment is derived from flying airplanes, "particularly other people's." Besides flying Uncle Sam's "to and fro across the Pacific, I have recently enjoyed delivering a client's C-53 to Mozambique via the North Atlantic and a Seabee to South America." He also has pleasant memories of "pushing my own ship about, including a seaplane to Newfoundland and Labrador and a transcontinental delivery on floats," Mr. Wolf reminisces, adding, "I still prefer being 'on the cuff' and will deliver other people's planes at the flick of an aileron. Any takers?"

Mrs. Wolf and the Philadelphia Section never have a dull moment.

Latest I.A.S. Publications



SECOND INTERNATIONAL AERONAUTICAL CONFERENCE

Covering the entire proceedings of the I.A.S.-R.Ae.S. Joint Conference held in New York, May, 1949, this 740-page volume contains 23 full-length papers, together with the important discussions of each. 360 illus. Bound vol.

Price—$17.50 ($15 to I.A.S. Members)

1st CONVERTIBLE AIRCRAFT CONGRESS PROCEEDINGS

The entire proceedings of the Congress held in Philadelphia, December, 1949, are covered in this one handy volume. The ten full-length papers on convertible aircraft, plus illustrations and important discussions of each paper, are included.

Price—$5.00 ($3.00 to I.A.S. and A.H.S. Members)

1949 AERONAUTICAL ENGINEERING INDEX

Here is the indispensable reference guide to all important technical papers and books on the aeronautical sciences published last year. Containing over 5,000 references and abstracts, indexed according to subjects, the volume for 1949 also contains a complete Author's Index.

Price—$5.00 ($3.00 to I.A.S. Members)

Indexes for 1947 and 1948 may also be obtained. In combination with the 1949 volume, these are available at following rates:

1947, 1948, and 1949 (3 vols.)—$10.00 ($7.00 to I.A.S. Members)
1948 and 1949 (2 vols.)—$7.50 ($5.00 to I.A.S. Members)

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New York 21, New York

Please send, postage prepaid, the following publications (as checked):

- ☐ **Second International Aeronautical Conference**
- ☐ **1st Convertible Aircraft Congress Proceedings**
- ☐ **1949 Aeronautical Engineering Index**
  - ☐ **1948 Index** ☐ **1947 Index**

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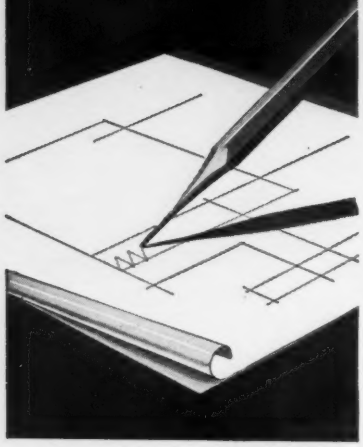

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I.A.S. Sections

Boston Section

W. G. Cornell, *Secretary*

At the December 14 meeting, Dr. Y. T. Li presented a talk based on the paper, "A New High-Performance Engine Indicator of the Strain-Gage Type," illustrated with slides and motion pictures. Twenty-six members attended.

New officers elected are as follows: Chairman, William O. Meckley; Vice-Chairman William R. Hawthorne; Secretary, R. Douglas Smith; and Treasurer, Gustav Kuerti.

Chicago Section

Alfred Stott, *Secretary*

A joint meeting was held January 4 with the Mechanics Colloquium of Illinois Institute of Technology. Chairman Harold V. Hawkins presided with 93 persons attending.

Speaker of the evening was Dr. Hugh L. Dryden who spoke on "Frontier Problems in Fluid Mechanics." Dr. Dryden outlined the fundamental equations involved in the study of fluid mechanics and expanded these to show their application to aircraft.

Dayton Section

Robert W. Hoeflein, *Secretary*

The annual meetings of the Dayton Sections of the I.A.S. and S.A.E. were held jointly December 20 with 150 persons attending.

Major General L. C. Craigie, Commandant, U.S.A.F. Institute of Technology, was the principal speaker. Title of his talk was, "Modern Systems of Aircraft Propulsion."

Hagerstown Section

Logan T. Waterman, *Secretary*

A. J. Thieblot, Chief Engineer, Fairchild Aircraft Division, spoke at the November 29 meeting on "Aircraft Design." Chairman D. W. Weller presided, with 74 persons present.

San Francisco Section

Joseph Stuart, III, *Secretary*

New officers elected for 1950 are: Chairman, Roy T. Nilsen; Vice-Chairman, Stanley Moy; Treasurer, John A. Stern; and Secretary, Joseph Stuart, III.

Professor Elliott G Reid was elected Representative to the I.A.S. Nominating Committee for Area Councilors.

Washington Section

Bernard Maggin, *Secretary*

On January 10, a dinner meeting was held attended by 58 members and guests, with 125 attending the meeting proper.

Speaker of the evening was Ivan H. Driggs, Director, Research Division, Bureau of Aeronautics. His subject was "Aircraft Design Analysis."

Student Branches

Cal-Aero Technical Institute

The December 6 meeting attended by 140 members and guests heard Lawrence Cherry, Head of the Analysis Division, Naval Air Missile Test Center, Point Mugu, Calif. Chairman Frank Seery presided.

Catholic University

On December 8, 60 members made a tour of the Naval Air Test Station, Patuxent River, Md. Woodrow Seamone, Chairman, and the Faculty Adviser, Mr. Cody, accompanied the group.

The visit was made at the invitation of Commander Connally, Chief of the Test Pilot Training School at the Station.

Massachusetts Institute of Technology

A business meeting was held January 12, and Prof. Otto C. Koppen's Helioplane was inspected on the school's football field.

Performance of the plane was demonstrated by a quick take-off in 100 ft. with an attack angle of about 45°. After a silent approach at about 30 m.p.h., the plane stopped at the end of a ground run of only three airplane lengths.

University of Notre Dame

Election of new officers was held January 12 with the following results: Chairman, Robert Kraemer; Vice-Chairman, Jim Martin; Secretary, Dick McMillan; and Treasurer, Nick Pagoria. Walter Geudtner presided as outgoing Chairman.

A film, *North American Combat Aircraft*, was shown.

University of Oklahoma

Victor Young, a Student Member and a member of the National Soaring Society, gave a talk on "Soaring" at the December 7 meeting. Chairman Robert L. Dickinson presided at the meeting attended by 40 members. The films, *Smoke Flow—Lift and Drag* and *Compressibility*, were shown.

A collection was taken up for the 300 men students of the Bachelors Officers Quarters, which they had been using temporarily as a dormitory. This building burned to the ground on December 3 with the loss of three lives. The I.A.S. contribution was added to the general fund.

Oregon State College

A film, *P-80 Shooting Star*, was shown at the December 7 meeting, Chairman Elliot R. Buxton presiding.

University of Southern Califorina

A talk, "Amateur Rocket Work," was given by David Elliot and Russell Sessing, members of Reaction Research Society of Glendale, at the November 29 meeting. Harry Gann, Chairman, and 102 members and guests were present.

Movies were shown illustrating the construction and a test-firing of simple solid fuel rockets, as well as the testing of a liquid fuel motor for a rocket.

Stewart Technical School of Aeronautics

On November 23, a trip was made to the Institute of the Aeronautical Sciences Museum and Library at I.A.S. New York headquarters. The group of 20 members were guided by Maurice Smith, Librarian.

A film was shown at the December 1 meeting, entitled *Flight Log*, which reviewed the progress of aircraft design from the Wright brothers to the present. On December 21, a talk, "Flight to the Moon," was given by George Jacobs, student member.

"SIXTH SENSE" for the Automatic Pilot

The new Kollsman Altitude Controller brings positive correction to automatic piloting for the precise maintenance of a selected altitude. Weighing only twenty-five ounces, this unit combines the famous Kollsman high-precision aneroid diaphragm, the recently developed Kollsman Synchrotel and an especially designed DC magnetic clutch. Sensitivity is such that the Altitude Controller will respond to as little as a two-foot change in altitude and motivate the autopilot accordingly.

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Chairman George Viteritti presided at the meetings.

Syracuse University

Two papers were given by Student Members Robert J. Reiner and Edward A. Stannard, entitled "Inverse Taper Ratio" and "Aerodynamic Heating Due to High Speeds," respectively, at the December 14 meeting. Chairman Philip R. Woodford presided.

Tulsa University

On January 5, three films were shown: *PBM-3 Wing Destruction Test, Fighter Strafes and Kills,* and *Target Tokyo.* Chairman Kenneth Murty presided.

News of Members

S. Alexeef, M.I.A.S., is employed as Stress Engineer by Piasecki Helicopter Corporation, Morton, Pa. New address: 4840 Sansom St., Philadelphia, Pa.

Richard C. Bizzozero, T.M.I.A.S., is now employed at Grumman Aircraft Engineering Corporation. Home address is 23 Homestead Lane, Levittown, L.I., N.Y.

Norman W. Carey, T.M.I.A.S., is Development Engineer, Baurer & Black.

Thomas C. Connor, T.M.I.A.S., has changed his position from Cristobal, Canal Zone, to Detroit, Mich. Home address is 2237 E. Canfield, Detroit 7.

William C. Etherington, T.M.I.A.S., is Engineer Grade IV in the Airplane Design Division of A. V. Roe Canada Ltd. A graduate of Syracuse University with a B.M.E. degree, Mr. Etherington received the I.A.S. Student Branch Lecture Award of 1949. New address is 92 Colbeck St., Toronto, Ontario, Canada.

John W. Goslee, T.M.I.A.S., was appointed an Aeronautical Engineer at Langley Air Force Base, Va., N.A.C.A. New address is 517 4th Ave., Portsmouth, Va.

Alan H. Green, M.I.A.S., received his M.S. in Aeronautical Engineering from CalTech and is now employed as Aeronautical Engineer (GS-11) in the Missile Test Department, U.S. Naval Air Missiles Test Center, Point Mugu. New address is 939-B 15 St., Santa Monica, Calif.

Yzb. Sadettin Gunturkun, M.I.A.S., formerly Research Assistant, Aeronautical Structures Laboratory, Brooklyn Polytech, has been appointed Department Head, Maintenance & Repair, Tayyare Tamir Fabrikasi, Eskişehir, Turkey.

B. J. Kaganov, M.I.A.S., is Chief Structures Engineer at Canadair Ltd. New address is 5582 Gatineau Ave., Montreal, Quebec, Canada.

Robert B. Kleinman, 1st Lt., T.M.I.A.S., returned to active duty with the Air Force and is stationed at Keesler Air Force Base. Address is 3380 Training Sq. (Spec. Sub.), Box 180, Keesler Air Force Base, Biloxi, Miss.

David G. Koenig, T.M.I.A.S., is now working for N.A.C.A. at the Ames Aeronautical Laboratory, Moffett Field, Calif.

Harvey G. McComb, Jr., T.M.I.A.S., is now with Consolidated Vultee Aircraft Corporation, San Diego. Home address is 3585 Villa Terrace, San Diego 4, Calif.

NEW VICE-PRESIDENT

G. J. Brandewiede, M.I.A.S., was named Vice-President of Maintenance & Supply, a new department formed last January 1 by American Airlines. He had been Materials Director prior to his promotion.

Albert S. Richardson, Jr., T.M.I.A.S., formerly Junior Development Engineer, Aerophysics Department, Goodyear Aircraft, now is with the Aeroelastic & Structures Research Laboratory, Department of Aeronautical Engineering, Massachusetts Institute of Technology, Cambridge, Mass.

C. F. Riley, Jr., M.I.A.S., who left the Research Staff of the University of Michigan Aeronautical Research Center, has accepted a position as Consultant with Booz, Allen & Hamilton, 135 S. La Salle St., Chicago 3, Ill.

Joaquin A. Saavedra, 2nd Lt., U.S.A.F., T.M.I.A.S., of 3820th Air University

(*Continued on page 80*)

NEW ENGINEERING DIRECTOR

Airborne Accessories Corporation has appointed William R. Hopkins, M.I.A.S., as Director of Engineering in charge of all engineering and development activities, reporting to C. F. Thompson, Vice-President, Formerly Chief Engineer, Special Products Division, American Bosch Corporation.

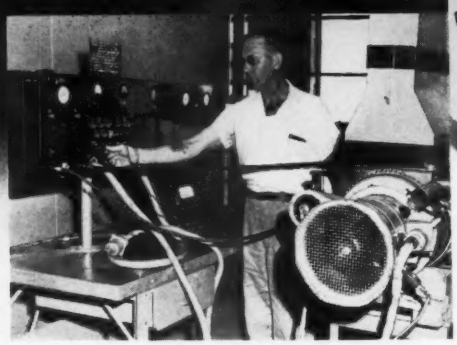
CHIEF OF DESIGN

William B. O'Neal, M.I.A.S., is now Chief of Design Sections for Canadair Ltd. Mr. O'Neal left The Glenn L. Martin Company where he was Senior Design Engineer. At Canadair he is responsible for direction of the design sections in the Engineering Department.

MISSILES MANAGER

S. M. Treman, M.I.A.S., has been made General Manager of the Guided Missiles Division of the Fairchild Engine & Airplane Corporation. Treman joined Fairchild in 1946, and since that time he has held various positions; more recently he was Acting General Manager.

Another Leader's Slogan



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PROF. J. ACKERET

Honorary Fellows for 1949

ARTHUR E. RAYMOND

The 1950 Honors Night Dinner, Hotel Astor, N.Y., January 23, 1950.

Editorial

I.A.S. Honors—1950

One of the cardinal purposes of Honors Night is to pay tribute to the leaders of American aviation—leaders of the present and, even more important, the potential leaders of the future.

The highest award that the Institute can confer is Honorary Fellowship. Every year, one citizen of the U.S. and one citizen of a foreign country may be selected by secret ballot from among the Fellows of the Institute. Implicit in election to Honorary Fellowship is long service of great value to aeronautics. Orville Wright was our first Honorary Fellow. We have just lost one of our most distinguished Honorary Fellows, General of the Air Force, H. H. Arnold. Other equally distinguished names are on our list.

We are adding two others on this occasion—the Vice-President in Charge of Engineering for the Douglas Aircraft Company, Inc., a long-time Fellow and a Past-President of the Institute, Arthur E. Raymond; and the Chief of the Institute for Aerodynamics of Switzerland, Prof. J. Ackeret.

[*Elsewhere in this issue of the REVIEW will be found the names of the newly selected American and Foreign Fellows (page 14). Also included (pages 12 and 13) are the names, histories, and citations of the winners of I.A.S. Awards for 1949.*]

In formally bestowing our Honors, we recognize those who have made outstanding contributions to the art and science of aviation during the past year. Aviation being the kind of business it is, the monetary value of the few awards that do convey honoria (a fancy word for a very small check) do not yet approach the value of the Nobel prizes!

They do, however, carry great prestige in the aeronautical world, and, most important, they carry the good will and admiration of all members of the Institute. They give us the opportunity—so often overlooked in this cold and hurried world—of personally thanking those who have accomplished good work during the preceding year—of giving them a hearty "Well done!"

W. A. M. B.

The Balance of World Power

Excerpts from the Honors Night Dinner Address of

WALTER LIPPMANN*

"WHAT I SHALL TALK ABOUT, would, if I were to give it a title, be 'The balance of power today—or the breakdown of the two power system in the world.'

"During the past year there have been certain critical developments that affect the balance of power between the Soviet Union and the United States. I don't suppose anyone would deny that the events I am about to name are of critical importance.

"The first is that the American monopoly of atomic weapons has ended.

"The second is the success of Mao Tse-tung in organizing the Chinese revolution under communist leadership.

"The third is the appearance of India, Pakistan, and Indonesia as independent Asiatic states.

"The fourth is the secession of Marshal Tito from the Soviet orbit in Eastern Europe.

"The fifth is the revival of Germany as a European power.

"None of these developments was, of course, entirely unforeseen. We have all known, unless we chose to disregard the views of men qualified to speak, that sooner or later most, if not every one, of these things were likely to happen. But no one predicted that they were all going to happen at about the same time. Yet it is the combination of these events which has, I believe, created a radically new situation that will compel all the governments to re-examine their estimates of the cold war, and their calculations and their policies.

"Here, I am submitting to you my own estimate of the new situation. Please regard it as a working hypothesis and not as a dogmatic conclusion. In general, then, I venture to suggest that the net effect of all these events combined marks the beginning of the end of the idea that the world must align itself in two coalitions: the one directed from Moscow and the other from Washington.

"Even before the events of this past year the two coalitions were by no means complete, and they were far from solid. We know to what lengths of suppression and terror and purging the Cominform has had to go in the satellite countries in order to keep them subordinated to the Kremlin. We know from our own experience how complicated has been the task of achieving unity of action in western Europe under the Marshall Plan and the North Atlantic Security Pact. And we know that in the Middle East, in Asia, and in China there has not even been a proposal, much less a plan, for uniting all the non-Soviet governments into an organized system of mutual aid. Everywhere, on both sides of the Iron Curtain, nationalist and separatist forces have interfered with the organization of the world into two great alliances.

Walter Lippmann, Columnist and News Analyst, with W. A. M. Burden, 1949 I.A.S. President.

"Nevertheless, it has been taken for granted for some time....that all the nations of Europe and of Asia must align themselves either with Moscow or with Washington and London.

"This idea, that the world must be divided into two camps, has been an article of faith, an unquestioned dogma, in the Kremlin. It is based on the teachings of Marx and Lenin, which all true communists must subscribe to. Now and then, to be sure, Stalin has given out interviews saying that the two worlds could live peaceably side by side—that war between them was not inevitable. But never has any orthodox communist, who is loyal to the Kremlin and to the Cominform, ever questioned the idea that there were two and only two possible worlds: that of Soviet Communism on the one hand and that of capitalism on the other.

"But not only communists have believed this Soviet dogma. It is widely accepted by the leaders of thought and action in the noncommunist world. They have assumed that every nation will be forced into the Soviet camp or that it will join the democratic camp—that those countries not yet aligned, particularly Germany, Japan, China, and the nations of south Asia, will each of them have to choose, that all the nations and the peoples of the world will choose, between communist domination and the Western democratic leadership, between the Russian ideology and ours, between their alliance and our alliance.

"The orthodox communists regard this theory as the guaranty of a beautiful hope. We regard it as an ugly necessity. But we have assumed that the theory

* News Analyst and Columnist.

is true. I contend that it is not true..... If we examine the facts rather than the theory, if we look at what is really happening and what is most probably developing in Asia and in Europe, we shall find strong reasons for doubting whether mankind can or will be organized into two, and only two, alliances.

"....Of the five great developments that came to a head in 1949, one was in the field of atomic energy. The other four were in the field of international politics, and they turned upon the rebellion of Tito; the revival of Germany; the Chinese revolution; and the new independence of India, Pakistan, and Indonesia.

"Before we consider atomic energy, I should like to point out that there is a common denominator in the four developments. In each case, one or both of the two coalitions has lost or is losing control of an important country; in no case is it at all certain that the one coalition has won the country that the other has lost.

"Russia has lost control of Yugoslavia. The tendency to break away from Moscow, which is known as Titoism, is manifestly at work in the other satellites. It is at work also in East Germany. The best evidence that it is at work among the satellites is the unending series of purges—all directed against Bulgarian, Czech, and Polish nationalists. The evidence that it is at work in East Germany is the degree to which the Soviets are making concessions designed to appease and to seduce the German nationalists. On the Soviet side of the Iron Curtain, the greatest threat to Soviet ambition and to Soviet power is the revival of nationalism, which takes the form of a resistance to Russian domination—to resistance even among veteran communists who, until recently, were the trusted agents of the Kremlin.

"I think it is no exaggeration to say of Germany that, with the establishment of the West German Republic and its unmistakable growth in political and economic power, we are in the process of relinquishing our control over the future of Germany. I think no one can go to Germany today and continue to think that Mr. McCloy and his colleagues, the British and the French High Commissioners, have it in their power to determine the future of Germany. They are, in fact, liquidating the power of the western allies over Germany. No doubt they still have a certain discretion as to the rate at which the Germans shall recover their sovereignty. But the time is already clearly in sight when the Germans will make German policy.

"I shall not dwell at any length on the developments in southern Asia, except to point to the well-known fact that the new states, of which the biggest and the most influential is India, have achieved their national independence. As they achieved it they have declared that they will not enter into the military and political coalition of the western powers. They have no intention, of course, of joining the Soviet coalition. Pandit Nehru was quite explicit on that issue when he was in the United States, and I have no doubt myself that only an overt military invasion of southern Asia by Soviet or Chinese communists armies could alter this decision.

"Americans should have no difficulty in understanding it. The nations of southern Asia are new states. When America was a new state 150 years ago, it adopted the same line of policy in relation to the French Revolution and the wars of that period that the new republics of southern Asia have adopted toward the revolutions and wars of this period.

"When we turn to the Far East, the obvious facts are that the Chinese government that we backed has been defeated, that the victorious leaders of the Chinese civil war are communists, that they have declared that they are the allies of the Soviet Union, and that they have gone first to Moscow and not to Washington.

"But it is by no means certain that the marriage of the two communist revolutions is indissoluble, or even that it has been consummated. The imperial interests of Russia and the national interests of China conflict all the way from Manchuria along a borderland that extends 4,000 miles into the heart of Asia.

"Therefore, while it is true that we have lost our power and most of our influence in China, it by no means follows that Russia has won what we have lost.

"As for Japan, our position has been seriously weakened by what has happened in China. The main economic connections with Japan are with the mainland of Asia. There lie the most important sources of their imports, and there are their principal markets. Nor can it be denied that the strategic security of Japan has been greatly affected by the fact that the whole mainland of east Asia, all the ports and airfields and the whole hinterland, are in communist and anti-American hands.

"I have left until last the event that was announced by the President on September 23—that there had been an atomic explosion inside the Soviet Union. This event signaled the end of the American monopoly of atomic weapons. Let us make the most favorable assumptions. Let us assume that we can make more bombs and bigger bombs, that we can build faster planes with longer range, and that we can organize better defenses to detect, to warn, and to intercept. Still, no one can doubt, it seems to me, that the military situation is different than it was when we had a monopoly of atomic weapons.

"The difference will, I believe, be felt soonest in the countries we have been discussing—that is to say, in the countries adjacent to the Soviet Union, especially in eastern Europe and in the Far East and still more specifically in Germany and in Japan.

"During the period of our monopoly, there existed a military stalemate between the Red Army and the American strategic air force armed with atomic weapons. The one was a deterrent upon the other. The military defense of western Europe and of western Germany rested on our capacity to bombard the vital centers of eastern Europe and of Russia. The military defense of the Soviet orbit rested on the capacity of the Red Army to occupy the vital centers of Germany and of Belgium and of France.

"The Soviet achievement of the atomic bomb, even if relative to us they have only a few bombs, has changed the balance of military power. For it has raised the critical question of how western Germany and Japan are to be defended against atomic bombardment. Until a few months ago that question did not have to be faced; it could be put off as one of those problems that, though it would have to be faced some day, was still hypothetical and in the future. It is now an actual problem.

"Both Germany and Japan have highly concentrated industrial areas. The ultimate defenses against air attack—namely, dispersion, and space—are not available to them. They cannot be made secure any longer by armored divisions, or by naval power, or by the threat of American aerial reprisal. Germany and Japan are, in fact, the ideal targets of atomic warfare. And even if it were technologically possible to create an effective aerial defense in western Germany and in Japan, the cost would be, I believe, prohibitive. For we have to remember all the other countries from Norway to Turkey and Iran which are vulnerable and to which we have offered a guarantee of mutual aid.

"We are compelled, therefore, to re-examine the strategic situation. For the strategic formula on which we have operated from the proclamation of the Truman Doctrine in the spring of 1947 to the signature of the Atlantic Pact in the spring of 1949 had as its major premise the American monopoly of the atomic bomb. Under this formula, our chief military problem was to design and construct aircraft capable of penetrating the Soviet defenses in order to deliver the bomb.

"Now we have the additional problem of creating defenses in a large number of countries which we have guaranteed, and two of which we occupy—defenses that cannot be penetrated by the Soviet air force carrying atomic bombs.

"Thus far there has been little public discussion of this problem in the United States. But I think I can tell you that it is being discussed anxiously abroad. Little has been said publicly about it. But the reaction beneath the surface is, nevertheless, profound. I have not been to Japan. But, recently, I have been to western Germany, to France, to the Middle East, and to southern Asia, and the effects of the new strategic situation are unmistakable to anyone who looks beneath the surface of things.

"In the exposed and vulnerable countries around the periphery of the Soviet Union, the effect, I believe, has been to reinforce decisively their natural impulse to disassociate themselves from the two coalitions and to seek such security as they can find by recovering their independence from both. For the new situation means that neither the U.S.S.R. nor the U.S.A. can offer the vulnerable countries any guarantee, or even any reasonable hope, of security against the fearful devastation of atomic warfare.

"There are Germans who would like to align themselves with the West. There are Germans, and not only communist Germans, who would like to recover their eastern provinces by a deal with the Soviet Union. But the determining fact for all Germans is that in neither alliance can they find the most elementary security. Membership in either alliance would expose them to the threat of irreparable damage from an atomic attack by the other alliance.

"They cannot once again become the allies of Russia, as they have so often in the past, because Russia cannot defend them, and they cannot defend themselves, against American air power. But, by the same token, western Germany cannot become the military ally of the West, as Field Marshal Montgomery so fondly hopes, because Britain and America cannot, with certainty and effectiveness, promise to defend western Germany against Russian aerial attack.

"The Germans are a highly intelligent people, especially in military matters when they are not befuddled by demagogues like Hitler. They are confronted with a dilemma and they know it, and there is only one way out of it open to them which offers them any prospect—even if it is not a certain prospect—of security. The Germans will take that way out. The evidence is accumulating that they are taking it. They will exploit their position between the two coalitions to recover their national independence by gaining concessions from both sides. They will restore their unity. They will shake off the controls. They will get rid of the military occupation. Then they will develop a middle position in the heart of Europe outside either alliance and in between both alliances. . . . .

"That is the course that India, Pakistan, and Indonesia have already decided to take"—one of avoiding entangling alliances.

"The logic of the German position is also, I believe, the logic of the Japanese situation. Since General MacArthur cannot guarantee Japan against atomic attack from the Asiatic mainland, the Japanese struggle to survive must take the form of a struggle to make Japan independent of both military systems.

"The same inexorable logic will affect the satellite nations of eastern Europe. They cannot be defended by Russia, and, obviously, they cannot be defended by the United States. Therefore, not only their best hope, but their only hope, for security is to disengage themselves from the clutches of the giant powers. Tito is already doing just that. All of them will be far better able to do the same sort of thing if and when Germany has recovered enough independent power to terminate the military occupation, to end the partition of Germany, and thus to roll away the Iron Curtain from the middle of the continent.

"This vast and complicated process, which is well begun but far from completed, is, in fact, the disintegration of the alliances. Perhaps I should say it is the disintegration of the paper projects and the blueprints of the alliances that were supposed to divide the world sharply into two systems—the one dominated by Moscow and the other led, subsidized, and armed by the United States.

"I believe that it would be undesirable and, in practice, impossible for the United States to resist this process and to attempt to reverse it.

"That is to say, it cannot any longer be the object of our policy to meet the Soviet expansion by organizing a coalition in which western Germany, Japan, and China are to be the principal outer bastions—in which the United States and Great Britain are to be the arsenal, the citadel, and the headquarters. That was a conceivable arrangement in the days when General Clay appeared to be supreme in western Germany, when General MacArthur appeared to be supreme in Japan, and when General Chiang Kai-Shek was still the chief warlord of the greater part of China.

"But now there is a western German republic, which is negotiating with Mr. McCloy as to how rapidly, but not whether, the full sovereignty of Germany is to be restored. In China, the collapse of Chiang and the victory of Mao Tse-tung have removed China from the sphere of American influence. In Japan, there has not as yet been such a visible dramatic change as in Germany or in China. But if we look ahead and if we see beyond the majestic facade of the military occupation, can we have any confidence that the vital connections of Japan with the mainland of Asia and the vulnerability of Japan to atomic bombardment from both sides will not push Japan into a policy of military and political neutrality?

"My own view is, therefore, that the paramount object of our policy cannot be to contain Soviet expansion by organizing a global coalition against Russia. The paramount object of our policy from now on will have to be to frustrate and to disorganize and to disintegrate the Soviet coalition.

"The critical areas in which such a policy must operate are Germany, eastern Europe, China, and Japan. We should not try to incorporate Germany into the military system of the Atlantic powers. It cannot be done. We should prevent Germany, as she recovers, from making an alliance with Russia. That *can* be done, and strategic air power should be the perfect instrument of that policy. We should influence and encourage the Germans to do what so many Germans already want to do—namely, to identify German nationalism and patriotism with German unity and with German independence. We should help the Germans to neutralize themselves in order to end the military occupation and the partition.

"We should support Titoism in eastern Europe by taking a firm and unequivocal stand, as in fact we have —not against communism as such, but against Russian imperialism and Russian aggression.

"We should do in China what Secretary Acheson has decided to do. We should offer Red China what we have offered all Chinese governments since the time of John Hay, 50 years ago—our support, which they will eventually need, against dismemberment and imperialist aggression.

"We should base our policy in Japan on a recognition of the vital interests of Japan—that, since she must trade with the Asiatic mainland, she must be allowed to have diplomatic relations with her two Asiatic neighbors; that, since she is peculiarly vulnerable to atomic attack by the Soviet Union and from the United States, she cannot be expected to align herself in the American military system or allowed to align herself in the Soviet military system.

"I am well aware that I cannot possibly have answered all your questions and met all your doubts. This is a big subject for what is, though it may have not seemed so while you listened to it, a short speech. But I should not like you to feel that I think I know all the answers and have resolved all my own doubts. I have not. I feel sure only that the basic conception of our foreign policy will have to be reconsidered and, in important respects, revised in view of what is happening in Germany and eastern Europe, in the Far East and southern Asia, and in the field of atomic energy.

"I think it highly probable that our best course is to work toward the general objective of disintegrating the Soviet coalition. That would mean that we put our influence and power behind the general tendency toward national independence, toward military neutrality, and toward diplomatic disentanglement—a tendency that is manifest in almost all of Asia and in much, at least, of central and eastern Europe.

"I believe that we can never afford to forget—as we form our policy—the true nature and the essential limitations of our power in the world. We have and can have great striking power exerted at long range. But our power to occupy, to fortify, and to hold secure large land areas on the other side of the two oceans is limited. We are not, and will never be, a great land power on the Eurasian continent.

"And, therefore, we cannot organize military coalitions inside the Eurasian continent which require the presence, or the immediate availability, of large American land forces. The kind of power that we have and that we can exert will not support a policy that seeks to organize the Eurasian continent into an anti-communist coalition. The power we have, however, will support a policy that seeks to deter the aggressions of the Soviet coalition by the threat of massive retaliation and which seeks to disorganize that coalition and to break it up by encouraging the natural human desire for national independence and for isolation from the ravages of war."

Impressions of the I.A.S. Eighteenth Annual Meeting—Part I*

DR. STEPHEN J. ZAND†
Lord Manufacturing Company

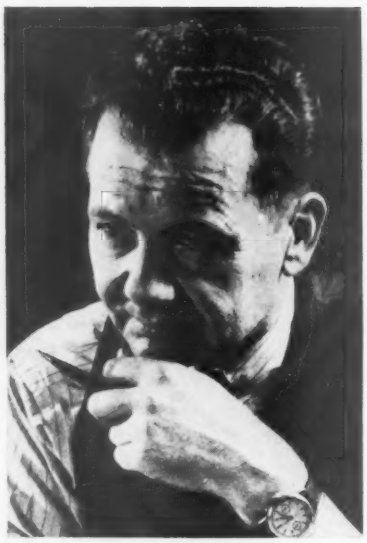
General Impressions

ONCE EACH YEAR the ballrooms of the Hotel Astor provide a retreat from pseudo science for the aeronautically minded, be they engineers, executives, students, or nontechnical followers of aviation. The Institute of Aeronautical Sciences Annual Meeting with its factual material, concisely presented and accompanied by irrefutable data, sends the space-ships and flying saucers and other "Buck Rogersiana" scurrying back to the pages of the comics and the Sunday supplements where they belong.

Yet, from the opening session on "Rotating Wing Aircraft," to the closing symposium on "Jet Installation Design Problems" and the visit to the ram-jet laboratory, the overall picture of the advancement in applied and pure aeronautical science presented at this year's meeting was one to fire the imagination, as well as to satisfy the technical demands of the most exacting engineer.

It is regrettable, but apparently unavoidable, that every worth-while program must include some overlapping sessions, making it necessary to choose between two sessions of equal importance and interest, scheduled for the same time. Monday morning, the choice was between "Rotating Wing Aircraft" and "Instruments" and on Wednesday, sessions on "Meteorology" and "Structures" shared the morning billing. Though, in the main, they were beamed to quite divergent audiences, a conflict of interests with attendant disappointment was the lot of many individuals.

In reviewing the program generally, it is apparent that hand in hand with the exploration of the unknown goes the securing of the gains that have been made as discoveries of the past become present practicalities. For example, the helicopter, which even yet may be considered the unorthodox among aircraft because of its unusual speed range and maneuverability, is well on its way to becoming a stable member of the aircraft family. In the session on "Rotating Wing Aircraft," the word "stability" appears in the title of two papers and the word "practical" in another. "Practical Instrument Flying of Helicopters" is this last title. "A Type of Lifting Rotor with Inherent Stability" and "An Explanation of Some Important Stability Parameters that Influence Helicopter Flying Qualities" are the other two.



In six of the eight papers in the two sessions on "Aerodynamics," the word "supersonic" appears in some form, yet it was a word that was used but rarely only a decade ago. "Aeroelasticity," a term introduced at the 1949 meeting by Martin Goland, achieved its majority this year by heading a full session, at which four papers relating to the subject were presented.

Air accidents during the past year may or may not have influenced the choice of subject matter for the "Air Transport" session, but it seems significant that the emphasis was on better safety measures. Two papers deal with progress in fire prevention: "In Flight" and "Following Crash"; these were followed by one on "Crash Worthiness" and one entitled "Safety Attitudes in Air Transport Operation." The 1949 sessions on "Air Transport" dealt with equipment, navigation, and control.

Balancing the technical program with the relaxing atmosphere of good cheer (usually too good and too abundant for the middle-aged appetite), visits with old friends and inspiring speeches of general interest, were the Honors Night Dinner and two luncheon meetings. The Honors Night Dinner, always a highlight, was especially distinguished by the presence of Walter Lippmann (editor, author, columnist, and news analyst) as featured speaker. Excerpts from Mr. Lippmann's talk may be found on pages 30–33.

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* Part II of this article will appear in the April issue.
† Vice-President in Charge of Engineering.

Presentation of the Institute's annual awards and honors, also reported elsewhere in this issue, preceded Mr. Lippmann's address.

The march of time is beginning to thin the ranks of the founder members, those pioneers of aviation who, undaunted, flew the first airplanes with built-in headwinds without navigational aids, or who, at their drafting boards and in their laboratories, confronted the problems presented by the new science and art, aeronautics. These were the men who made up, in large measure, the founders of the Institute back in 1932. In the 18 years since that founding date, those fortunate enough to return again and again to the annual meeting miss many familiar faces in the ever changing picture, which now includes three generations. New faces and personalities are closing the ranks, sharing the responsibilities of research, and taking an active part in Institute affairs. "The mantle of Elijah falls upon Elisha."

Technical Sessions—Some Reporting, a Little Criticism, and Some Well-Deserved Praise

The first session on Monday morning, held jointly with the American Helicopter Society and presided over by Dr. Alexander Klemin, was devoted exclusively to papers on helicopters. The first of these was "Practical Instrument Flying in the Helicopter" by Messrs. Cannon and Niehaus, of the Bell Aircraft Corporation, Niagara Falls, N.Y. The authors stressed the fact that helicopters, in order to be of use under all weather conditions, cannot depend on the fact that they can rise and descend vertically but must be equipped with proper instruments for executing this and other maneuvers under poor visibility conditions. When the helicopter speed exceeds 40 m.p.h., then the problem of instrument flying in this craft is no different from that encountered in an ordinary airplane, and instrumentation based on the conventional horizon and directional gyro can be used. The authors tested a number of pilots with varying experiences and admit that instrument flying in the helicopter is more difficult to master than in the airplane. They stress the fact that our knowledge of the natural stability of this craft is inadequate and point out that research in that direction should be extended because stability, just like in an airplane, is the key to instrument and eventually to automatic flying. An interesting and thorough discussion of the need of a reliable air-speed indicator in the low-speed range is presented, since success in being able to fly by instruments in the full range of speeds from zero to maximum depends largely on the solution of this problem. The authors also describe a possible omnidirectional radio device and go into the discussion of a glide path type of radar device. The conclusions of the paper indicate that the problem of instrument flying in helicopters is a difficult one and that continuous research must be pursued with vigor if routine flying under "zero" conditions is to be attained in the near future.

"A Type of Lifting Rotor with Inherent Stability" by Kurt H. Hohenemser, Chief of Aerodynamics of the Helicopter Division, McDonnell Aircraft Corporation, St. Louis, Mo., is a paper of particular interest to the helicopter designer because it gives him ideas to increase the inherent stability of a rotor without recourse to external stabilizing devices. The author discusses the main parameters that are responsible for the longitudinal control and stability characteristics of the helicopter. The complexity of such an analysis can be appreciated from the fact that there are nine longitudinal stability derivatives to be taken into consideration. Fortunately, only four are of major influence on the flying qualities, and the effect of these four derivatives is presented in detail. This paper, like many others, was very hard to present because it contains many complex mathematical expressions and considerable tabular material. Mr. Hohenemser overcame this obstacle with ease, showing that he has mastered the subject thoroughly.

One can sense from the paper, "An Explanation of Some Important Stability Parameters That Influence Helicopter Flying Qualities" by Alfred Gessow and Kenneth B. Amer, Langley Aeronautical Laboratory, N.A.C.A., that the helicopter is maturing, since more and more research time is spent on the most difficult aspect of helicopter engineering—stability. This paper attempts to provide some fundamental guidance to the understanding of stability and control and does it in such a way that even the fixed-wing specialists can understand the peculiarities and complexities of stability and control of rotary-wing aircraft. What is particularly interesting is the comparison, from a point of view of stability, of the airplane with the helicopter. As usual whenever any member of the N.A.C.A. presents a paper, the preparation and rehearsing prior to the delivery has its beneficial effect on the audience. The authors lectured without reference to the manuscript, which is quite an achievement, particularly when one considers the difficult textual matter.

A refreshing ending to the helicopter session was provided by a purely descriptive paper by Harry Jensen (Chief Test Engineer, Sikorsky Aircraft Division, United Aircraft Corporation), who describes the 1,000-hp. Sikorsky helicopter rotor blade test stand in the paper entitled, "Design and Operational Features of the Sikorsky 1,000 hp. helicopter Rotor Test Stand." Illustrated with good photographs, this lecture shows how much testing has to be done in order to design a satisfactory rotor and what a tremendous amount of measuring equipment is necessary to collect the required data.

Under the Chairmanship of Richard M. Mock, three interesting papers on instruments were presented. Mr. Victor B. Corey, of Frederic Flader, Inc., discussed "Acoustical Measurement of Air-Stream Parameters."

For many years the measurement of air speed has been practically universally accomplished by means of the Pitot-static differential pressure gage. As long as

Technical Sessions

Informal group shots of some typical speakers panels

Rotating Wing Aircraft

Instruments

Structures

airplanes flew at moderate heights and speeds, this instrument was sufficiently accurate, and the correction of data due to temperature variation and compressibility effects did not present a particularly difficult problem. The moment one exceeds Mach Number 0.6, or so, compressibility effects have important bearings on the results; further difficulty arises from the fact that reliable measurements of temperature at high speeds are difficult to accomplish because the temperature sensitive element is heated by the friction of the passing air. Since the velocity of sound in air depends on temperature alone and enters explicitly into the relationship involving the Mach Number and the true air speed, one can speculate that sound itself can provide means of measuring these parameters directly. The paper describes attempts to produce such an instrument. The acoustical, mathematical, and vectorial solutions are interestingly presented, and the paper, so to speak, offers a direct approach to the accurate and direct measurement of the Mach Number, the true air speed, and the true air temperature of air streams through the use of the velocity of sound. The accuracy of the method is exemplified by the fact that measurements of Mach Numbers over a wide range of speeds in a subsonic tunnel agree closely with data collected by the use of conventional methods. No details of the actual instrument and its mechanical-electrical and acoustical construction are revealed, probably for security reasons. To appreciate the depth of this new theory, the reader or the listener must be familiar with the theory of acoustics, including supersonics, and have a good knowledge of vector analysis. He must also have an anticipatory mind, since the author introduces the coined word "stamni," operating with it for more than a printed page and explaining only at the end of six paragraphs what "stamni" is! It is *S*onic *T*rue *A*ir-speed and *M*ach *N*umber *I*ndicator.

The use of strain gages, since their invention in Switzerland some 30 years ago by Dr. A. H. Huggenberger, has reached a point where they are used more and more on a variety of static and dynamic problems. Henry H. Hoadley, Research Department, United Aircraft Corporation, in his paper entitled, "An Internal Six-Component Balance for Model Testing at High Speeds," has presented an old application of the strain gage to a new design of a six-component balance suitable for mounting inside a small sting-supported airplane model to be tested at high subsonic or supersonic velocity. His balance is particularly adaptable for the researcher in supersonics, since it provides small interaction of forces and moments. The paper was ably presented and drew considerable comment from the audience. Temperature correction was the main topic discussed from the floor, and Mr. Hoadley had the answers at his finger tips.

The highlight of the instrument section, both from the point of view of textual matter and able presentation, was a paper entitled, "A Precision Omni-Directional Radio Range for the Terminal Area" by Joseph Lyman, Engineering Department Head, and George Litchford, Engineering Section Head, Aircraft Radio Research Department, Sperry Gyroscope Company. It is gratifying that this paper has been released at such an early date, for it will stimulate further thinking and research by other scientists. It reports on the development of a type of radar system capable of providing polar coordinate azimuth guidance of unusual precision to be used by airplanes in congested landing areas. The assumptions the authors made are courageous, since the capacity of the system, for example, is visualized to be 120 airplanes per hour, which means that at the assumed 120 m.p.h. speed the landing airplanes are separated by only 30 sec. The effects of inaccuracy of present systems are discussed, and the precision of the

(*Continued on page 51*)

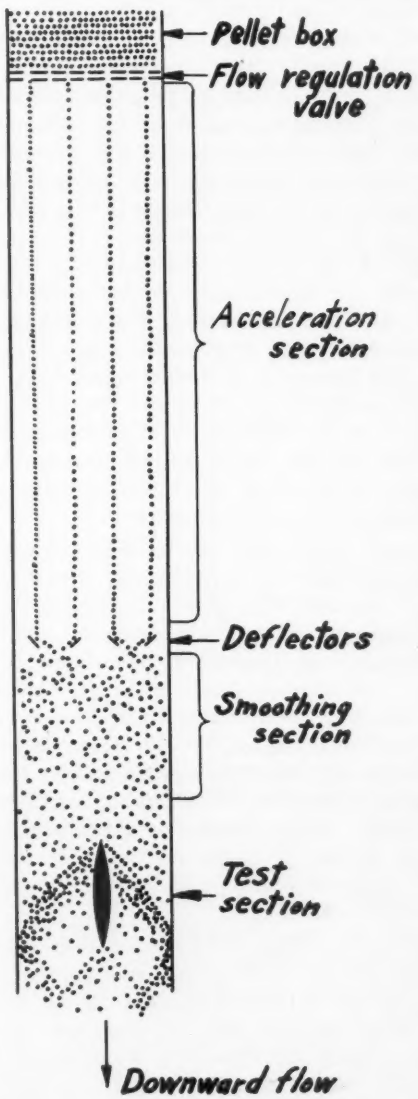

Fig. 1. Schematic diagram of simple mechanical analogy apparatus.

Rear Admiral Bolster*

on

"Current Research and Development Trends in Naval Aviation"

Excerpts from the Luncheon Address at I.A.S. Annual Meeting, January 24

"As MANY OF YOU ARE FULLY AWARE, the management and direction of a broad research and development program, such as that in Naval aviation, under our present ground rules, is a somewhat complicated procedure. Joint planning and coordination of our research and development projects at the working level, in aviation, is, of course, not new either to the Navy or to the Air Force, since we did this for years through the old 'Aeronautical Board.' Disestablishment of that board and creation of new methods and procedures for proper coordination and cooperation in every field among all the Armed Forces has created many new problems for all of us. We are making real progress in this effort, however, and there can be no question but that the broad overall research and development program for all the services which this effort produces is a real step forward. . . . .

"The basic objectives of our research and development programs must be fairly obvious. But I believe they bear repeating. Our goal is to provide aircraft, guided missiles, and related components and equipment that will enable our naval forces to maintain control of the sea—which means control of the air over the sea and the defeat of enemy forces whether over, on, or under the surface of the sea. It also means the utmost in cooperation with our sister services in order that we may all work together to provide a sound, well-balanced fighting team. In this connection, joint research in aeronautics by the Air Force, the N.A.C.A., and the Navy, although not well publicized, has long been an established fact. . . . .

"In considering these problems and their relations to our research and development work as a whole, I find it convenient to think of our effort as one that can logically be divided into three broad groups. It also seems to me that this type of grouping is one that readily lends itself for use as a good basis or framework for planning interservice cooperation.

"My first group includes our broad fundamental and applied research programs, which furnish the basic scientific facts concerning such fields as aerodynamics, hydrodynamics, new structural materials, new chemical substances, electronic or sonic phenomena, and so on. These are the projects that create the solid foundation on which real progress depends. This type of information is generally useful to military, naval, and civilian aviation.

"My second main group or subdivision comprises our many component and systems development programs that continue to make available those new or improved equipments or combinations of equipments, each of which contributes some vital function to the overall success of the aircraft in which it is installed or which it helps to operate.

"The third subdivision, as will probably be obvious, consists of our development program of complete experimental prototype aircraft. In the Navy, these prototypes are usually the end product resulting from design competitions. Here, all the best 'know how' available, the best materials and techniques, and the latest components and systems are combined in one assembly, as an airplane, helicopter, airship, or guided missile, to permit it to carry out its role in the total Naval air warfare operation.

"Returning now to the first subdivision . . . . as would be expected, our most important field of interest is aerodynamics, and we look to the National Advisory Committee for Aeronautics for continuing research in this field. Transonic and supersonic flight problems have, if possible, accentuated the great importance of learning all we can about the mysteries of aerodynamics. We, of course, obtain information from the wind tunnels of the N.A.C.A., from the telemetered research tests at Wallops Island, and from our own

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* Rear Adm. C. M. Bolster, Assistant Chief of Research, Bureau of Aeronautics, Navy Department.

high-speed research aircraft. The outstanding success of both the X-1 and D558-2 in flying faster than sound certainly shows that real progress is being made in this important field.

"Another interesting subject to the Navy is that of hydrodynamics. In this field, we instituted several years ago a cooperative research program with the N.A.C.A. and the Stevens Institute of Technology at Hoboken, aimed at the improvement both hydrodynamically and aerodynamically of our seaplane designs. We were convinced that no really rational method of approach to the problem was in existence and that no important advances would be possible until more of the unknown facts of hydrodynamics were understood.....

"Turning to the solid materials field, much of our research is conducted by contract through the Office of Naval Research. There are many important projects, such as investigations leading toward the ultimate availability of high-strength magnesium, improved titanium alloys, plastics, and various composite structural materials. Typical projects in the liquid materials field are noninflammable hydraulic fluid work, carried on so successfully at the Naval Research Laboratory, and the important problem of producing improved lubricants to withstand the rigorous conditions existing in today's aircraft turbine engines. Research to uncover better conventional fuels and new or improved liquid and solid rocket propellents is also receiving our vigorous attention.....

"In trying to manage our programs in such a way as to accomplish the maximum result with a minimum cost, there are two important features of this broad research effort: The first point is that we use existing facilities of other Government activities, which we consider best qualified to do the work, to the maximum extent possible—augmented by research in contractors' facilities and in universities. The other point is that many of the fields of research in which we are interested are also of vital concern to the Air Force and, frequently, to civil aviation, with the result that many of the projects and programs are joint efforts financed by the Air Force, Navy, and N.A.C.A. all together, or by some combination of these agencies.....

"The second broad subdivision of our work, as stated above, consists of the development of new or improved components and equipments. In this group I would place all manner of so-called hardware items, such as power plants and their accessories, instruments, electronic equipments, automatic pilot systems, turrets, and all the other important elements.....

"Turning to the power-plant development work going on, the Navy has realized for some time that, although a simple exhaust nozzle added to a gas-turbine engine provides a light propulsive system, such a device will never be very efficient. The high specific fuel consumption resulting from such inefficiency can frequently be tolerated because the saving in power-plant weight more than compensates in many designs for the added fuel and tankage that must be carried. We, frankly, do not like this situation aboard ship, since we have to carry all the fuel for the ship-based aircraft in the ship's tanks and logistically these large fuel loads present a serious problem.

"It is also evident that, as the range of the aircraft is increased, a point will be reached where the fuel weight increases so much that the lighter and simpler engine no longer can be used. Our solution to this problem is the turbopropeller engine. It has been realized for some time that, even at a Mach Number of 1, the turboprop could compete with the turbojet if the propulsive efficiency of the propeller is equal to or greater than about 55 per cent—that is, if a propeller can be built with an efficiency of 55 per cent at a forward speed corresponding to a Mach Number of 1, the same thrust horsepower and specific fuel consumption can be obtained from a turboprop engine as from a turbojet. When cruising at lower speeds, the efficiency of the turbojet decreases while that of the turbopropeller increases, so that the two engines show a wide divergence in specific fuel consumption in this speed range. A further advantage of the turboprop is realized in Naval aircraft for carrier operations where short take-off run and low 'power-on' stall speeds are required and not readily obtainable in turbojet planes. These facts have led to intensive research by the N.A.C.A., instituted primarily by the Navy. The results to date have been so favorable that the Navy and the Air Force, in conjunction with the N.A.C.A., are planning a full flight propeller research program.....

"The Navy, in sponsoring turbopropeller propulsive systems, is developing a six-bladed, dual rotation propeller for the T-40 series engines. The program has covered not only the propeller proper but also the turbopropeller controls necessary for compatible operation of the turbine-propeller combination. In addition, we have brought along an eight-bladed dual rotation propeller and controls suitable for the same engine. The Navy's great interest in complete exploration of the potentialities of the turbopropeller combination, in addition to the hoped for fuel economies, stems naturally from our operating requirements—the high thrust necessary for seaplanes and carrier-based aircraft during take-off, good low-altitude performance, and good overall performance at all operating altitudes.....

"Other vital component development programs are under way in electronics, armament, flight instruments, automatic pilots, high-speed escape methods, and in the development of the all-important launching and arresting equipment for our aircraft carriers.

"A typical example of such work is a project initiated by the Special Devices Center as part of the Navy's all-weather flight program. This project has produced an improved automatic flight control system that shows great promise of being able to control the aircraft not only while cruising but also while making an approach and landing..... Although this autopilot will require additional development before it can reach

the production stage, prototype models have been built and thoroughly flight-tested. Many successful automatic approaches have been made with the autopilot, and several were carried to the touch-down point.....

"Another example of forward-looking component development is the work currently being performed on the escape capsule. The problem of working out satisfactory methods of assuring survival of flight personnel, under emergency conditions, at the speeds and altitudes that will be attained by future combat types, is a difficult one. Add to this the problem of survival after coming down at sea and the magnitude of the problem is apparent.....

"In carrying out component developments such as fall under this broad subdivision, there are several joint projects financed by the Navy and the Air Force as a cooperative endeavor. In this category we have occasionally found that our end-use differed enough from that of the Air Force either to warrant a different approach to the solution of a problem or, as in the case of carrier equipment, to do everything ourselves. Sometimes, of course, a different approach to the same problem is desirable. The important feature of the work on components is that there be free and complete exchange of technical information at the working level.....

"My last general subdivision of our research and development effort includes the ultimate goal or end product of all this work—the prototype aircraft and missile development programs.....

. . . ."When jet aircraft were first considered for carrier operations we were frankly concerned. We knew that tricycle landing gear would simplify landing techniques somewhat, but we also knew that 'power-on' stall conditions would be worse. The many special strength requirements, such as in the landing gear, in the air frame itself for catapulting and arresting, provisions for wing-folding, and proper aerodynamic design to give adequate control at low speeds, are critical factors. Thus, while there are many basic research programs we gladly and profitably share with the Air Force, and many component problems we are jointly able to solve together, each service must, in general, develop its own aircraft designs. . . . . The important thing here is, of course, that we all be fully aware of what is going on to take mutual advantage of prototype development wherever feasible.....

"In the field of carrier-based aircraft, we, of course, are working on new types to meet our several operational responsibilities. For antisubmarine warfare, we are presently developing and testing aircraft of the AF series designed to operate in pairs, one for search and one for attack. A considerable effort that is resulting in marked technological advances in equipment should soon provide our fleet with even more effective antisubmarine warfare aircraft.

"Turning attention now to our fighter and attack carrier-based aircraft, we feel that excellent advancements have been made in recent years, and I assure you this progress is continuing. We plan eventually to replace all carrier-based piston-engine fighter and attack aircraft with either turbojet or turboprop types.....

"It appears to me that this review of our recent Naval aricraft projects would be incomplete if I failed to discuss briefly and on rather general terms the performance of carrier-based aircraft versus land-based aircraft of similar types. The rather erroneous conclusion is sometimes drawn that carrier-based aircraft must, of necessity, be inferior in performance to the land-based types because of the rigid requirements demanded for shipboard operation. Admittedly, there is some weight penalty imposed on our aircraft to meet specifications for high landing loads, arrested landings, catapult launchings and wingfolding, and high lift devices. However, there are compensatory factors that must be recognized. The Navy, by the use of narrow high-pressure tires, has been able effectively to house the landing gear in the thin wing sections, which are so necessary for today's high-performance aircraft. As another important consideration, the overall useful load can be substantially reduced compared to the land-based counterpart, since time consumed for taxiing and launching is kept to an absolute minimum by catapulting from a base the mobility of which simplifies the combat problem. Our requirement for good low-speed control also gives excellent control at altitude. I merely mention these facts to show that carrier aircraft have certain real design advantages.

"The ultimate performance attained as a result of these various factors shows clearly that our designs can, when operating from a carrier, compete favorably with their land-based counterparts."

Major General Putt*

on

"Air Force Research and Development"

An Abstract of the Luncheon Address at I.A.S. Annual Meeting, January 25

THE ONE NATIONAL RESOURCE in which we may maintain a natural world superiority is in United States technology and in the application of this technology to national defense. This technical superiority and its application can only be maintained by the close relationship of industry, research organizations and institutions, and the Armed Forces. We shall always depend on scientific and research organizations—such as the National Advisory Committee for Aeronautics, colleges, and universities—for the preponderance of basic research. The Armed Forces must be responsible for establishing requirements in terms of characteristics for weapons systems. Close cooperation between the three is necessary if we are to maintain technical superiority. A prime instrument in maintaining this close cooperation is the Institute of the Aeronautical Sciences, and it is unique in this respect because its membership is composed of individuals from industry, scientific and research organizations, colleges, universities, and the Armed Forces.

An analysis of Air Force Research and Development problems indicates ten areas toward which our effort is directed. These are: background research, basic research, flight at faster speed, recognition and hitting of targets, ability to cause destruction, all-weather operations, defeating enemy interference, communications, defense of home territories, and utilization of personnel.

Background Research

The Air Force has, for over 3 years, supported a program of study and research to investigate preferred methods and techniques in the conduct of intercontinental air warfare in the interest of most effective national defense.

In essence, these analyses consider the performance, reliability, vulnerability, accuracy, costs, and logistic factors pertaining to the components of the weapon and to the weapon system as a whole.

From these studies, we are better able to balance our research and development program by ensuring that components required for the optimum system receive adequate research and development emphasis and that we eliminate projects that will not contribute. This searching analysis also allows us to determine with greater confidence, the expected time at which advances will be completed and thus justify the initiation of component developments far in advance of the expected completion of the weapons system itself.

Basic Research

In the field of basic research, our second area, the Air Force continues to support fundamental studies in fields of promise for the discovery of new knowledge that may prove to be of value to the Air Force. Inasmuch as no field of science is intrinsically inapplicable to the solution of Air Force problems and because all fields of basic research are continually in need of sponsorship through Governmental funds, the real problem becomes one of selecting the most promising areas for research and concentrating on those in which there is the greatest likelihood of success.

In recognition of this problem, the Air Materiel Command has elevated the Office of Air Research to a position paralleling that of its Engineering Division. The Office of Air Researc his collecting skilled representation in the various fields of science to program Air Force research so as to best meet Air Force needs in the conduct of its assigned roles and missions.

At the end of fiscal year 1949, the Air Force had in effect more than 400 research contracts, with a total face value of more than $75,000,000. Approximately 350 of these contracts were being pursued by nonprofit institutions.

* Major Gen. Donald L. Putt, Director of Research and Development, Headquarters, U.S. Air Force.

Flight at Faster Speed

The third area is concerned with the research and development necessary for flight at faster speed and the efficient transport of heavy loads—the provision of the vehicle. We have progressed from subsonic to supersonic speeds in the field of aircraft and missiles. The ability to fly great distances has increased enormously. Load-carrying ability has kept apace. However, we still have requirements for increased abilities in both speed and range. Present vehicles possess either long-range or high-speed abilities but not both, as exhibited by a heavy bomber compared with jet aircraft.

Progress in the guided-missile program has been highlighted by the emergence of the program from the design and study phase into the flight-test phase and by the integration of the Air Force program with those of the other services to form a truly national program.

Fiscal year 1949 may well be termed "The Year of Decision" for future propulsion of Air Force aircraft. Satisfactory progress in aircraft gas-turbine development and considerable experience with experimental jet aircraft has provided a reasonable basis for evaluating the various forms of propulsion for high-speed combat aircraft now under design. In conformance with overall Air Force plans and objectives, the decision was made to concentrate the limited propulsion development funds on turbojet engines and rocket-assist take-off for all new combat aircraft designs of the Air Force. This decision, however, did not eliminate the requirement for continuing the development of propellers for reciprocating and turbopropeller engines to be used in future transport and certain ground support aircraft where high speed is not the first priority consideration.

Notable advancements in the gas-turbine, ram-jet, and rocket-propellent development fields were made during 1949. Studies related to the application of nuclear energy to the propulsion of aircraft were actively continued by the Air Force-sponsored Nuclear Energy Propulsion for Aircraft Project. Considerable progress was made during the year, in cooperation with the Atomic Energy Commission, the National Advisory Committee for Aeronautics, and the U.S. Navy to further crystallize technical feasibility studies and to integrate a joint program of effort for solving problems in materials, reactors, shielding, power cycles, and airframe design configuration.

Recognition and Hitting of Targets

Projects have been initiated to make navigation automatic. As an example, a notable achievement along this line was the successful demonstration of a heretofore unproved system—wherein a completely automatic flight of several hundred miles was made in a pilotless airplane.

Radar may be used as an aid on approaching the target with personnel being able to take over visually—weather permitting—upon arrival at the target area. In conditions of no visibility, actual recognition of the target and bomb release is effected by radar evaluation.

Much progress has been made during the past year in developing an accurate bomb-aiming device for bombardment aircraft. A new bombing and navigational system is undergoing engineering tests and should be completed shortly. The system has successfully undergone accuracy tests and, at this time, appears capable of accurate bomb-aiming from altitudes and at speeds above those now operationally feasible. Considerable effort has also been expended to increase the stability of bombs in flight.

Ability to Cause Destruction

The Air Force has determined that the diversity of bomb sizes in existence during World War II, and in storage at this time, exceed the requirements of the Air Force. A study of this situation is expected to result in a recommendation to develop a new family of bombs having an optimum number of sizes. In the field of special munitions, the Air Force is relying largely on the efforts of outside agencies for basic research. A new family of warheads and fuses is required for guided-missile application where extremely rigid weight-performance requirements necessitate research for all possible improvements.

All Weather Operations

Present landing systems cannot keep a large number of planes separated in a crowded airspace or provide a sufficiently accurate approach path to effect 100 per cent landings in zero ceilings and visibility.

The geophysical research program is designed to make nature work for instead of against us. A key criterion for swift flight is the ability to predict a minimal flight path, basing the selection on the wind patterns of daily global weather. Substantial time- and fuel-savings are effected by following this procedure. As techniques for making accurate extended hemispheric weather forecasts for these purposes do not exist, the Air Force is vigorously pursuing research in this field.

Until recently, the atmosphere above 200,000 ft. was practically untouched. The use of the rocket as a sounding vehicle has extended dramatically the range of atmospheric probing and has made it possible for scientists to gather a wide range of data in the ionosphere.

Our All-Weather projects are of mutual concern to commercial interests. The program is coordinated with the Department of Commerce through the Air Navigation Development Board.

Defeating Enemy Interference

We are developing bomber aircraft that will fly roughly at double the speeds and altitudes of World War II aircraft, and the attacking fighter no longer enjoys marked performance superiority over the bomb carrier. Two new penetration fighters, the XF-88 and XF-90, are presently undergoing experimental

flight testing and will be evaluated, along with the F-93, to meet production requirements for this type fighter. All three aircraft will have sweptback wings and a performance superior to our current production fighters. A comprehensive air-borne-weapons study, initiated to determine the relative effectiveness of weapons suitable for use on future production aircraft, has progressed to the point of submission of recommendations.

With regard to fire control for aircraft weapons, newly developed equipment has shown considerable promise, and, on the basis of preliminary tests, action has been taken to incorporate these in new-type aircraft.

Communications

The utilization of aircraft for long-range bombing and reconnaissance, for defense and short-range offense, and for intercontinental transport requires radio communication equipment that falls into two distinct classes: long range to 6,000 miles, ground-to-air; and short range to 250 miles, ground-to-air and air-to-air.

Present development programs put emphasis on means for: increasing the range of long-distance communications; research to provide antijamming; provision of automatic and printed message for long-range communication; reducing the size and weight of the short-range equipment for jet aircraft, where space for accessory equipment is almost nonexistent; and investigation in ionospheric physics and solar noise for the purpose of better understanding, and ultimately compensating for, atmospheric factors affecting communications.

With the advent of high-speed aircraft and the expanded use of electronic equipment to accomplish a variety of operational functions within the aircraft, the Air Force is confronted with the severe problem of developing flush antennas for installation in aircraft. On high-speed aircraft, external antennas present a severe mechanical drag and icing problems. Progress has been made in the design of antennas which enable them to be mounted flush with the skin of the aircraft.

Defense of Home Territory

Defense of home territory is defined herein to include the air defense of large continental areas containing many potential targets of varying size, together with island bases and forward combat areas. Factors to be considered in the air defense problem are enemy capabilities in regard to: performance of intruder aircraft, potential damage of developed weapons, tactical employment of weapons systems, missile development, and effectiveness of countermeasures. The final factor is the degree of protection to be attained.

The increased speed, range, and combat ceiling of bombardment aircraft allow a flexibility of attack to the enemy which must be countered by a high-performance interceptor fighter capable of operating at night or in any weather the enemy might choose to utilize as protective cover. The range limitations of ground search radar, combined with the upper subsonic speeds of the attacking bomber, narrow the interception period.

Interceptor studies are presently being conducted by the major aircraft and equipment industries, and consideration is being given to the design of a fighter with low wing loading to reduce the radius of turn at high altitudes. The desirability of transonic and supersonic speeds for interceptors is also being investigated.

Extensive improvement in the ability to defend local areas will be afforded by the addition of guided missiles as armament for interceptor aircraft and by the introduction of surface-to-air guided missiles able to intercept intruding aircraft and guided missiles at relatively short ranges. During the past fiscal year, a flight-test program was initiated using the first full-scale test vehicle of an air-to-air missile.

Considerable development effort has been continued on the extension of ground radar ranges and coverages and the elimination of the human element in the chain of events occurring from the initial detection of the target to the final interception.

Utilization of Personnel

The U.S.A.F. has established a broad and comprehensive research and development program in the field of human resources. This program, designed to support various Air Force activities by improving operations with the application of research results, includes work in five areas: (1) human engineering, (2) personnel and training, (3) man power, (4) human relations and morale, and (5) planning and administration.

While this program is Air Force-wide in scope, its research operations are presently concentrated in the Air Training Command, the Air University, and Headquarters Command.

This newly activated program has gone through a planning phase during 1949. Its record of accomplishments already includes the development and placing in operational use the most comprehensive series of classification tests ever to be used with Air Force personnel (U.S.A.F. Airman Classification Battery).

Work has also been initiated in support of the U.S.A.F. Career Plan, development of improved proficiency measures, and improvement of training of technical and flying specialists. Research is being conducted in support of military management, psychological warfare, and strategic intelligence.

Conclusion

We feel that these ten areas of research and development effort, when placed together correctly, give us a complete picture—the complete structure of the Air Force Research and Development effort. Interlaced throughout all the ten areas, we find certain problems, requirements, or categories of operations. A change in our capability in one of the fields immediately affects capabilities in the other areas. Each field or area mutually supports the rest, resulting in a firm structure.

A Word About Preprints

By

*Welman A. Shrader**

THE INSTITUTE'S PREPRINTS have taken on a "new look." As illustrated on the opposite page, the conventional format used in the past has given way to a more compact and practical type of presentation.

The new style preprint differs from the old in two main respects: (1) the binding is done along the short, instead of the long, side of the $8^1/_2$- by 11-in. page; (2) two pages of an original manuscript are reproduced on a single page of the preprint. The result is a neat, easy-to-read, and less-cumbersome-to-file paper. Of even greater importance, the reproduction cost has been considerably reduced.

For the past 3 years, the Institute has attempted to supply preprints of all papers presented at national meetings. This has been possible through the use of a separate fund donated for the purpose by Sherman M. Fairchild and known as the Fairchild Publication Fund. Since this Fund is not inexhaustible, it has been used as a capital operating "kitty" with the idea of ultimately making the production and sale of preprints a self-supporting service. While this point has not yet been reached, it is expected that the format and policy changes outlined here will put this operation on a more nearly break-even basis this year.

Unfortunately, no one has yet discovered a truly cheap way of reproducing lengthy technical papers in small quantities. This is particularly true where illustrations, halftones, and formulas are involved. Regardless of the reproduction process used (and the Institute has tried them all), the unit cost of the finished preprint is ofttimes incompatible with the probable demand for copies of the paper.

Every paper presented at an I.A.S. meeting is important to some particular group or segment of the aeronautical profession. The degree of importance, the size of the interested group, and the possible ultimate demand for advance copies differ with each paper and subject. It is sometimes difficult to anticipate accurately this demand, particularly since the very manner in which an author delivers a paper can affect its immediate popularity.

These and other problems connected with the preparation and distribution of preprints have been carefully studied by the Institute's publication staff during the past few years. Experiments with all types of reproduction methods and practical experience with the distribution of a wide variety of papers have led to the following conclusions and changes in policy:

* Director of Publications, Institute of the Aeronautical Sciences, Inc.

(1) A slightly reduced but direct reproduction of the author's original manuscript (via the photo-offset or planograph process) is the cheapest and most satisfactory method of providing preprints in the required quantities. All preprints published during the coming year will therefore be reproduced in this fashion.

(2) Since the reproduction cost of each paper varies in direct proportion to the number of manuscript pages and halftones involved, a graduated scale of prices has been established. All I.A.S. members may continue to obtain preprints at the established cost figure. Nonmembers will be required to pay an additional premium.

Helpful Hints to Authors

This adopted method of producing preprints imposes certain mechanical problems that can be entirely eliminated at the time the author is preparing his manuscript. Since the preprint is, in effect, nothing more than a reduced "photograph" of the original manuscript, the author controls the looks of the finished product. Whether the preprint is neat in appearance, easily readable, and a useful tool depends to a large degree on how the manuscript is typed and illustrated.

For this reason, the following general suggestions may prove helpful:

(1) The manuscript should always be typewritten on white paper, using only a black ribbon. Lines should be double-spaced. (Since the color blue does not reproduce in this process, manuscripts typed with a blue ribbon or reproduced on a Ditto or Duplicator machine are not satisfactory for making preprints.)

(2) If formulas or other hand-written material are included, use black ink only. As the entire manuscript will be reduced in size, make all hand-written characters, figures, etc., large enough to be readable when photographed down to half size.

(3) Illustrations and figures should be made black on white, using paper (or photographic prints) of uniform size and not over $8^1/_2$ by 11 in. Captions for illustrations should be typed or hand-lettered directly on (above or below) the illustration. (Ink drawings on tracing paper or cloth are acceptable.)

(4) If graph paper is used in plotting curves, making charts, etc., use black ink on paper having light-blue grid lines. (These will automatically disappear in the photographic process.) Do not use paper having red, brown, or other dark color grid lines.

(5) Photographs should be of uniform size: maximum 8 by 11 in. (Photographs should be used only

when absolutely necessary. It is not always practical, from the expense standpoint, to include too many halftone photographs in preprints.)

(6) The completed manuscript must be in the Institute's hands at least 2 weeks before the paper is to be presented.

THE INFLUENCE OF DESIGN PARAMETERS ON THE PERFORMANCE OF SUBSONIC AIR INLETS
by
HOWARD E. ROBERTS, Group Leader
and
B. D. LANGTRY, Aerodynamicist
Douglas Aircraft Co., Inc.
Preprint No. 260
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274*	Maintenance of Safety Attitudes in Air Transport Operation—Robert Knight.	0.35	0.75
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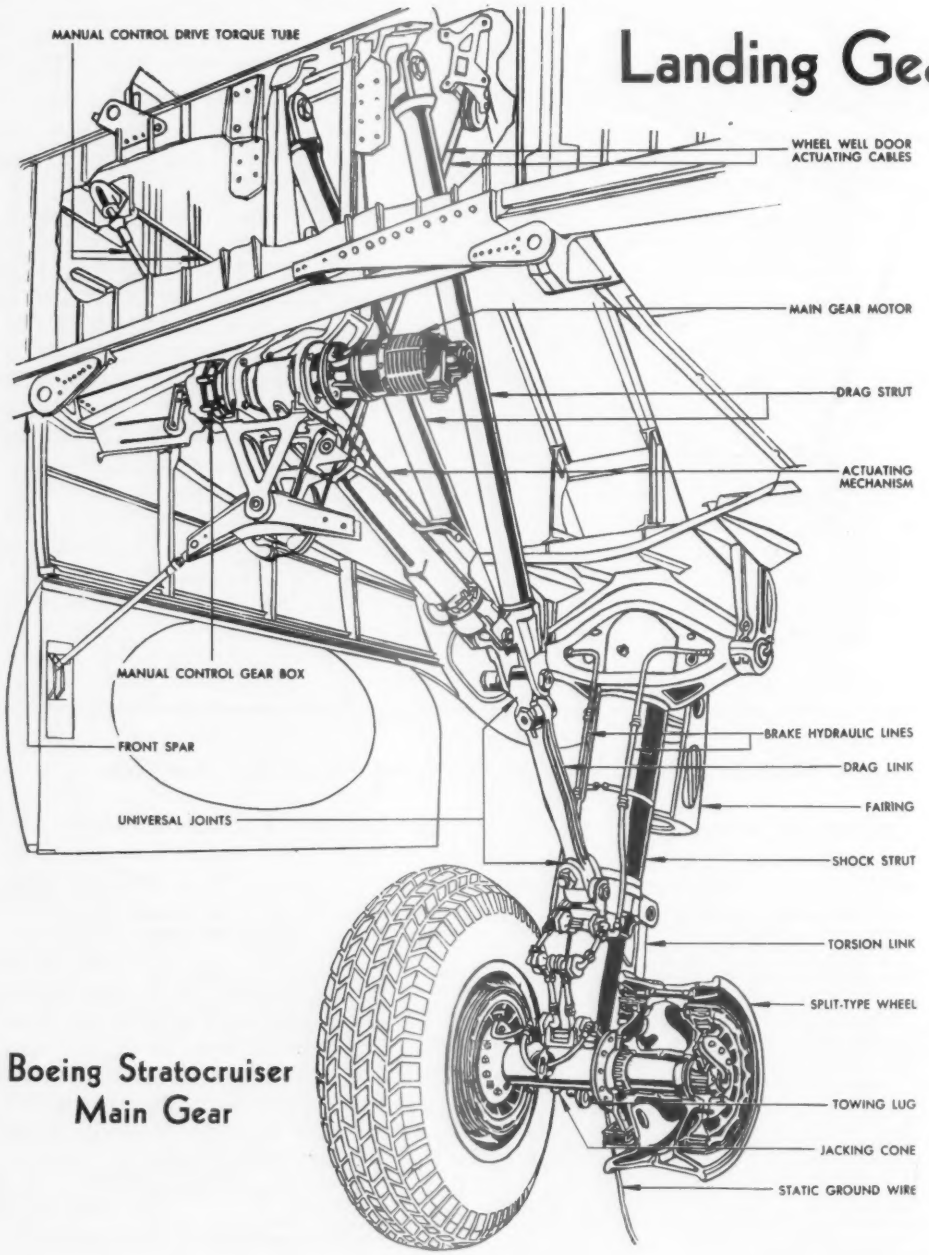
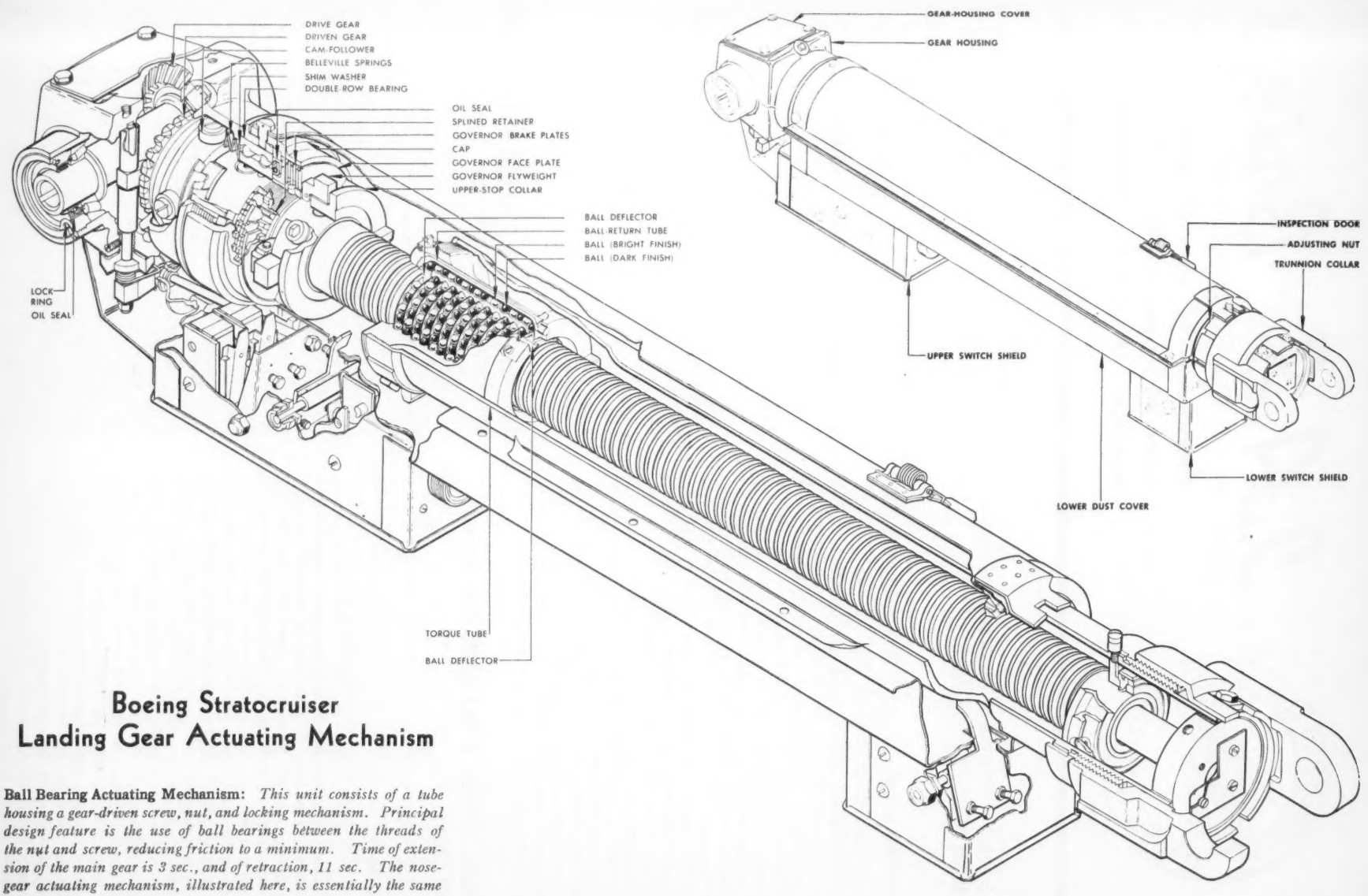
Design Trends

Landing Gears



Boeing Stratocruiser Main Gear

Principal Elements: *There are three elements in the Stratocruiser's landing gear—the shock strut, which is the load-carrying member; the drag strut and drag link, which are the stabilizing members and the retracting mechanism. The retraction mechanism can be operated by two independent controls: the main gear motor and manual-control gear box. The hydraulic lines to the brakes adjacent to the oleo housing are of flexible nature in order to permit free action of the shock strut. In earlier designs, this freedom of action was accomplished by means of flexible hose. With recent development in hydraulic design, working pressures have increased, and the hose assemblies have been replaced with a swivel joint assembly. Hydraulic pressure is carried through the assembly to the inner brake expander tube of each wheel and, by means of additional tubing, along the centerline of the axle to the outer expander-tube assembly of each wheel. Total landing gear weight is 7,022 lbs. (This includes main and nose gears.)*



Boeing Stratocruiser
Landing Gear Actuating Mechanism

Ball Bearing Actuating Mechanism: *This unit consists of a tube housing a gear-driven screw, nut, and locking mechanism. Principal design feature is the use of ball bearings between the threads of the nut and screw, reducing friction to a minimum. Time of extension of the main gear is 3 sec., and of retraction, 11 sec. The nose-gear actuating mechanism, illustrated here, is essentially the same as that of the main gear.*

I.A.S. Briefs

Summaries of current papers accepted for publication or presentation at I.A.S. Meetings

The Effect of Variation of Mass on the Dynamic Stability of Jet-Propelled Missiles

By

M. V. Barton

The University of Texas

The variation of mass of a jet-propelled missile, caused by expending fuel, produces jet damping forces that, in addition to the variation of the mass itself, effect the dynamic stability and, hence, the flight behavior of the missile. The equations of motion in the vertical plane for an airjet-type missile and a rocket-type missile having a constant rate of loss of mass are developed, and the characteristics of the jet damping forces are indicated. The equations of motion are solved for the simplified case of a symmetrical rocket missile in free flight, and an evaluation is made to determine the effect of a gust disturbance on the subsequent behavior of the missile. These results are compared with the behavior of a constant mass missile. It is shown that the disturbance of the variable mass missile damps out more rapidly than it does for the constant mass missile, indicating that the variable mass missile is more stable. The oscillation frequency for the variable mass missile increases with time and is greater than the oscillation frequency for the constant mass missile.

Dynamic Stability at High Speeds from Unsteady Flow Theory

By

I. C. Statler

Cornell Aeronautical Laboratory, Inc.

A study is made of the longitudinal dynamic response characteristics of a typical fighter-type jet-propelled airplane based upon unsteady flow theory. The 14 longitudinal dynamic stability derivatives are evaluated as complex functions of reduced frequency and Mach Number and used to determine the frequency response curves of normal acceleration and pitching velocity. The results are compared to the corresponding responses computed on the basis of the "quasi-steady" theory, which neglects the effects of frequency and the higher order derivatives and includes the classical "time-lag" of downwash in the form of an $M\dot{\omega}$ term. It is shown that the discrepancies between the two can be accounted for by using the actual phase lag of the downwash as determined by nonstationary flow theory instead of the "time-lag." However, the differences between the simple and the exact results are so small that the inaccuracies of using $M\dot{\omega}$ are probably no greater than those of the original theoretical assumptions or the experimental data.

Please do not order Preprints of these papers at this time.

See pages 45 and 52 for Preprints that are immediately available.

On a Family of Oblique Shock Curves

By

Edward R. C. Miles

Institute for Cooperative Research

The curves $M \sin \sigma = \text{constant}$, where M is the free-stream Mach Number and σ is the shock angle, are level curves for the principal pressure, density, and temperature ratios across an oblique shock. If these curves are adjoined to the family of shock polars, dynamic relations, as well as the kinematic relations associated with the shock polar, are exhibited graphically. It has been customary to obtain these curves by interpolation. In this note, a simple analytic representation is derived.

Supersonic Tests of Conventional Control Surfaces on a Double-Wedge Airfoil

By

Michael Pindzola

United Aircraft Corporation

Results of supersonic tunnel tests made to obtain the characteristics of conventional control surfaces are summarized. A symmetrical double-wedge airfoil of 7 per cent thickness, with 15 and 30 per cent trailing-edge flaps, was used as a model. Pressure measurements and Schlieren photographs of the airfoil were taken in a two-dimensional channel at Mach Numbers 1.38, 1.48, and 1.58. The pressure data were reduced to lift coefficient, drag coefficient, lift to drag ratio, section moment coefficient, flap moment coefficient, and center of pressure points for every test angle of attack. Comparisons of the experimental data were made with the linearized and shock-expansion theories of references 1, 2, and 3. Agreement with Busemann's second-order linear theory and the shock-expansion theory is good except where such unpredictable phenomena as the following exist: (1) the shock detachment from the leading edge of the airfoil, (2) the forward movement of the shock emanating at the hinge point of the flap, and (3) separation on the upper flap surface to a limiting case at which the top trailing-edge shock moves to the hinge point. The tests were especially significant in determining

the effects of these irregularities on airfoil characteristics. Since a presentation of all the material is somewhat lengthy, only representative results are given in this paper.

Investigation of Lateral Dynamic Stability in the XB-47 Airplane

By

Roland J. White

Boeing Airplane Company

This paper presents the method and analysis used to improve the lateral stability of the XB-47, which was a part of the U.S. Air Force development program on this airplane. Early flights indicated a tendency for the airplane to "Dutch Roll" at the lower indicated air speeds. Elimination of this flight condition has been accomplished by use of a servomechanism termed a "yaw damper," consisting of a yaw rate gyro pickup that operates the rudder to improve the airplane damping in yaw. The resulting flying qualities are believed to be considerably better than would be possible with other means of improving the dynamic stability. Problems encountered during the design and flight tests are discussed. A method of analysis based upon the airplane inverse frequency response characteristics has been used, from which the airplane stability has been obtained. This method has been extended to include the effect of airplane body side bending which influences the dynamic stability at higher indicated air speeds.

Leading-Edge Singularities in Thin-Airfoil Theory

By

Robert T. Jones

Ames Aeronautical Laboratory, N.A.C.A.

If the thin-airfoil theory is applied to an airfoil having a rounded leading edge, a certain error will arise in the determination of the pressure distribution around the nose. It is shown that the evaluation of the drag of such a blunt-nosed airfoil by the thin-airfoil theory requires the addition of a "leading-edge force," analogous to the well-known leading-edge thrust of the lifting airfoil. The method of calculation is illustrated by application to (1) the Joukowski airfoil in subsonic flow and (2) the thin elliptic cone in supersonic flow. The paper concludes with a general formula for the edge force which is applicable to a variety of wing forms.

Analysis and Design of Stiffened Shear Webs

By

Paul H. Denke

Douglas Aircraft Company, Inc.

A simplified graphical solution of a previously published elastic energy analysis of shear panels is presented. Comparison is made between the results of the analysis and experimental data, and satisfactory agreement is found. A qualitative description of the failure of flat and curved shear panels is given, together with an example of the stress analysis of flat panels. It is concluded that a rational, easily applied and satisfactorily accurate method has been developed for determining the stress distribution in stiffened shear webs. It is expected that future development, some of which has already taken place, will permit the prediction of ultimate loads not only for thin web beams but also for curved panels typical of wing and fuselage structure.

Minimum Weight of Stiffened Cylindrical Shells in Pure Bending

By

W. R. Micks

The RAND Corporation

Methods previously developed for determining minimum weight of stiffened cylindrical shells in bending are extended to include the weight of the circumferential frames. For a specified diameter and bending moment it is possible to minimize the total weight of shell and frames. Curves are presented showing the variation of frame weight, panel weight, and total weight with variations in structural index and frame spacing. These curves may be used to indicate the weight penalty incurred by using nonoptimum design.

Comparison of Analytical and High-Speed Mechanical-Calculator Solutions of the Lateral Equations of Motion of an Airplane, Including Product-of-Inertia Terms

By

M. W. Fossier, R. W. Bratt, and D. G. Dill

Douglas Aircraft Company, Inc.

Two methods are derived for solving the lateral equations of motion of an airplane slightly disturbed from steady symmetric flight. One method consists of solving the equations analytically, and equations are derived for the motion of an airplane resulting from constant applied forces and moments. The second method gives a step-by-step solution in matrix form, suitable to calculation by a high-speed mechanical computer, such as an IBM calculator. Solutions computed by IBM calculators may be done with a considerable saving in time as compared with the analytical solutions. This saving is a function of the number of cases to be calculated. In addition, the possibility of error, high in the analytical solution, is reduced considerably.

Calculations are made for a hypothetical sweptback-wing fighter-type airplane by both methods. It is found that there is no difference in the results as calculated by each method.

The effect of including product-of-inertia terms in the calculations of response characteristics and dynamic stability is investigated on the same airplane. It is found that, for the longitudinal principal axis inclined above the flight path, the inclusion of product-of-inertia terms improves the stability and decreases the rolling performance from that calculated without the product-of-inertia terms.

Steady Flow of Nonviscous Elastic Fluids in Axially Symmetric Channels

By

M. H. Vavra

United States Naval Postgraduate School

Subject matter is the axially symmetric steady flow of a nonviscous elastic fluid, with constant total energy, between

two arbitrary coaxial surfaces of revolution. By means of orthogonal curvilinear coordinates, a transformation of the Eulerian equation of motion is obtained which permits the determination of the meridional velocities for arbitrary distributions of the tangential velocity components. Based on this relation, an iteration method is described which serves to calculate arbitrary three-dimensional flow fields.

An application of the theory to an irrotational flow in an inlet channel for a centrifugal compressor wheel shows the importance of determining the flow ahead of rotating wheels in order to evaluate the correct inlet conditions for the impeller.

Rotational motion gives flow patterns that are entirely different from those of irrotational motions. Depending on the vorticity and the shape of the channel contours, there exist definite relations between the meridional and the tangential velocity components to make possible a stable motion that follows the channel surfaces without separation.

The method is particularly suited to determine pressure gradients in curved diffusors and inlet ducts of compressors and turbines in order to estimate the possibility of flow separation.

Some Recent Measurements in a Two-Dimensional Turbulent Channel

By

John Laufer

California Institute of Technology

The paper describes detailed measurements of mean and turbulent velocity fields in a two-dimensional fully developed turbulent channel flow, including distributions of velocity fluctuations, correlation coefficients, and microscales. It presents results of measurements in the laminar sublayer and discusses Reynolds Number effects on the turbulent velocity field.

Special I.A.S. Publications

Sherman M. Fairchild Publication Fund Papers

No.		Price
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101	Introduction to Shock Wave Theory—J. G. Coffin, Kaiser Fleetwings, Inc. 106 pages; 33 work tables & charts. (July, 1947, p. 28.)† (Ozalid.)	$3.50*
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104	Tensor Analysis of Aircraft Structural Vibration—Charles E. Mack, Jr., Research Engineer, Grumman Aircraft Engineering Corporation. 66 pages; 6 illus. (April, 1947, p. 28.)† (Ozalid.)	$2.50*
105	An Evaluation of the Importance of Fatigue Phenomena in Aircraft—C. R. Strang, L. R. Jackson, L. F. McBrearty, R. V. Rhode, and R. L. Schleicher (A Round-Table Discussion). 34 pages; no illus. (Mimeographed.)	$1.10*
106	Measurement of Ambient Air Temperature in Flight—W. Lavern Howland, Lockheed Aircraft Corporation. 13 pages; 5 illus. (Ozalid.)	$0.50*
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167	On the Pressure Distribution for a Wedge Penetrating a Fluid Surface—Experimental Towing Tank, Stevens Institute of Technology. 36-page booklet; 13 illustrations. (Photo-offset and Multilith.)	$1.00*
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* A 25% discount on these prices is allowed to Institute members. † Indicates issue of Review in which summary of paper appears.

Plan Now to Attend

Seventh Personal Aircraft Meeting

Hotel Lassen, Wichita, May 19–20

I.A.S. 18th Annual Meeting

(*Continued from page 37*)

proposed systems is prognosticated. The details of the high-accuracy azimuth measurement system were ably described, and even the completely uninitiated could understand that such devices are entirely within the realm of possibility. The block diagrams shown in the slides proved again that a good picture is worth a thousand words. Dr. E. P. Warner led the discussion and commented that such precise landing systems will materially expedite the landing of passengers in congested areas. As an old friend and former coworker of Mr. Lyman, this reviewer cannot resist the temptation to introduce a personal mark of appreciation for this paper—good show, Joe!

Since aerodynamics is one of the most important sciences for aeronautical engineers, three sessions were devoted to it, and the subjects will be treated in this report as if they were presented consecutively.

The first session was under the able Chairmanship of the Reed Award winner, George S. Schairer, Boeing Airplane Company, Seattle, Wash. H. Reese Ivey, Langley Aeronautical Laboratory, N.A.C.A., gave the first paper, "A Mechanical Analogy for Hypersonic Flow." For an opening paper one could not have chosen a more fascinating subject. Here, again, the remarks made previously about the delivery by an N.A.C.A. trained scientist apply fully. Despite the fact that the subject is new and spectacular, the speaker did not refer to the manuscript, for which the listeners were grateful.

It is known that supersonic flow can be visualized easily by means of schlieren photographs or other well-known methods. Naturally, those methods require a substantial investment in the apparatus and personnel. Another complication arises from the fact that one has actually to produce supersonic flow and possess a high-speed wind tunnel that must be operating at the time such visualization is contemplated.

After explaining the basic nature of the mechanical analogy, Mr. Ivey shows that hypersonic flow (from Mach Number 5 to infinity) can be shown by making small pellets of glass or plastic fall in a transparent tube, depicting shock waves when such pellets fall on an airfoil section. From the photographs, one can clearly see the gradual flow evolution. It is also possible to derive quantitative force measurements from this analogy, but one has to keep in mind the limitations of this system. One has always to bear in mind that air molecules are elastic but that the particles used to simulate molecules made of 4,000 to 5,000 round glass spheres are not. A lively discussion after this paper showed that the research and preparation of the photographs was worth while. (See Fig. 1 on page 37.)

The second paper, presented by G. Grimminger, Scientific Warfare Advisor, Department of Defense, Washington; E. P. Williams, Engineer, and G. B. W. Young, The RAND Corporation, entitled, "Lift on Inclined Bodies of Revolution in Hypersonic Flow," suffered from unfortunate organizational difficulties. The preprints for this paper were not available. The text was rather interesting (it deals with the importance of body lift that can be obtained when designing winged missiles, thereby improving their performance). Mr. Grimminger's new duties kept him so occupied that, as he himself said, "I did not have the time to read this paper for 6 months" and asked the audience "to bear with him." They did, but after 20 min. or so some of the listeners left the room, demonstrating once again that it is unfair for a speaker to be ill-prepared—unfair to the subject, to the audience, and to himself.

(To be concluded in the April issue.)

I.A.S. National Meeting Schedule

Fifth Annual Flight Propulsion Meeting—Hotel Carter, Cleveland—March 24

Seventh Annual Personal Aircraft Meeting—Lassen Hotel, Wichita—May 19–20

Annual Summer Meeting—Western Headquarters Building, Los Angeles, July 12–14

Members or organizations wishing to submit papers for presentation at National Meetings should send outlines or summaries to the Committee at least 3 months prior to the meeting.

All papers submitted will be considered for publication in the *Journal of the Aeronautical Sciences* or the *Aeronautical Engineering Review*.

All correspondence should be addressed to
The Meetings Committee
Institute of the Aeronautical Sciences
2 East 64th Street, New York 21, N.Y.

I.A.S. Preprints

Preprints of Meeting Papers Currently Available

No.

171 Preliminary Development of a Jet-Propelled Helicopter—Roy E. Marquardt, President, Marquardt Aircraft Company.

172 The McDonnell Ram-Jet Helicopter—Charles R. Wood, Jr., Chief Helicopter Test Pilot and Manager, Helicopter Contracts, McDonnell Aircraft Corporation.

173 A Method for Improving the Inherent Stability and Control Characteristics of Helicopters—R. H. Miller, Associate Professor of Aeronautical Engineering, M.I.T.

174 Recent Developments in Rotary-Wing Aircraft—I. I. Sikorsky, Engineering Manager, Sikorsky Aircraft Division, United Aircraft Corporation.

175 The Pfund Sky Compass—Joseph B. Matthews, Jr., Head Navigation Branch, Airborne Equipment Division, Bureau of Aeronautics, Navy Department.

176 A Liquid Oxygen Converter for Aircraft—W. A. Wildhack, Chief, Missile Instrumentation Section, Electronics Division, and D. S. Goalwin, National Bureau of Standards.

178 The Sperry Zero Reader—S. Kellogg, Engineering Department Head for Flight Instruments, and C. F. Fragola, Engineering Section Head for Electronic Development, Sperry Gyroscope Company.

179 Convertible Aircraft—R. S. Barnaby, Chief, S. M. Berkowitz, Project Leader, and W. H. Colcord, Assistant Chief, Aeronautics Section, The Franklin Institute.

180 Present Status of Research on Boundary-Layer Control—A. E. von Doenhoff and L. K. Loftin, Full Scale Research Division, Langley Aeronautical Laboratory, N.A.C.A.

181 Measurements in Flight of Spanwise Wing Loading—W. Lavern Howland, Flight Service Engineering Supervisor, Lockheed Aircraft Corporation.

182 Some Problems Concerning the Three-Dimensional Flow in Axial Turbomachines—Frank E. Marble, Instructor in Aeronautics, Guggenheim Aeronautical Laboratory, California Institute of Technology.

183 Aerodynamic Hysteresis as a Factor in Critical Flutter Speed of Compressor Blades at Stalling Conditions—A. Mendelson, Lewis Flight Propulsion Laboratory, N.A.C.A.

184 Designing for Gas Turbine Materials—M. H. Young, Chief, Materials Laboratory, Wright Aeronautical Corporation.

187 Dynamic Stability at High Speeds from Unsteady Flow Theory—I. C. Statler, Aerodynamicist, Flight Research Department, Cornell Aeronautical Laboratory.

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192 Some Recent Measurements in a Two-Dimensional Turbulent Channel—John Laufer, California Institute of Technology.

197 A New Approach to the Design of Metering Pins in Oleo Struts—R. M. Rosenberg, Associate Professor of Aeronautical Engineering, University of Washington.

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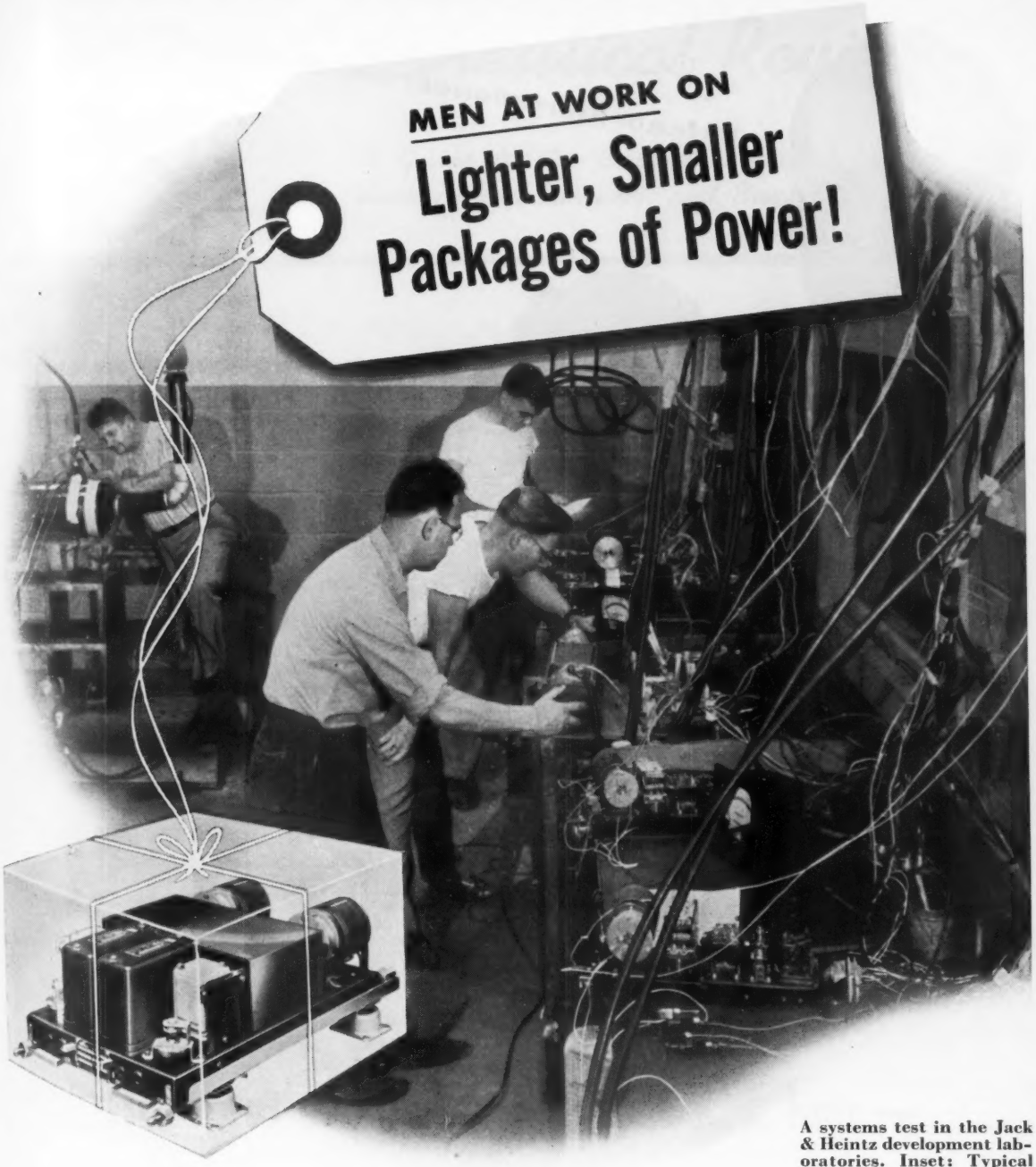

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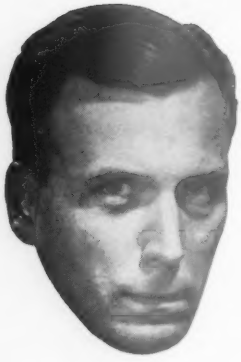

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Aerodynamics (2)

BOUNDARY LAYER

A One Parameter Method for the Calculation of Laminar Boundary Layers. R. Timman. *Netherlands, Nationaal Luchtvaartlaboratorium, Amsterdam, Rapport, Nr. F. 35,* 1949. 17 pp., figs. 9 references. (In English.)

Based on von Kármán's equation of momentum transport for boundary-layer flow, a new assumption is made for the velocity profile, which takes into account the maximum possible number of boundary conditions at the wall and the asymptotic behavior of the velocity profile at the outer edge of the boundary layer. Comparison of the results with known exact calculations shows a definite improvement over those obtained by the methods of Pohlhausen, particularly in the region of retarded flow.

Skin Friction in the Laminar Boundary Layer in Compressible Flow. A. D. Young. *The Aeronautical Quarterly* (Royal Aeronautical Society, London), Vol. 1, Part II, August, 1949, pp. 137–164, figs. 16 references.

A general semiempirical formula for the skin friction on a flat plate at zero incidence, both with and without heat transfer, in a uniform flow of a perfect gas with constant specific heat. The formula retains the form of an approximate solution of Crocco's integral equation for the viscous stress but the constants are adjusted to give the best overall agreement with the available calculated results for particular cases. When applied to the solution of the momentum equation of the boundary layer on a cylinder with zero heat transfer, the accuracy of the method thus developed cannot be gaged because of lack of accurate results for comparison. The result, however, is correct for the case of zero external pressure gradient. When the method is used to estimate the distance to separate from a flat plate in the presence of a constant negative velocity gradient, the results for high Mach Numbers differ considerably from those obtained by Howarth who used a method analogous to that of Pohlhausen. Both methods agree in predicting a rapid forward movement of separation with increase of Mach Number at the leading edge for constant ratio of velocity fall per unit length of plate to initial velocity.

CONTROL SURFACES

Flight Investigation on a Fighter-Type Airplane of Factors Which Affect the Loads and Load Distributions on the Vertical Tail Surfaces During Rudder Kicks and Fishtails. John Boshar. *U.S., N.A.C.A., Report No. 885,* 1947. 46 pp., illus., diagrs., figs. 8 references. U.S. Govt. Printing Office, Washington. $0.30.

Low-Speed Model Tests on the Effect of Nose and Gap Details on Elevator Characteristics. J. E. Adamson and E. G. Barnes. *Gt. Brit., Aeronautical Research Council, Reports and Memoranda No. 2326,* May, 1940. 27 pp., figs. 15 references. British Information Services, New York. $1.25.

FLUID MECHANICS & AERODYNAMIC THEORY

A Simplified Theory of "Simple Waves." A Ghaffari. *The Aeronautical Quarterly* (Royal Aeronautical Society, London), Vol. 1, Part II, August, 1949, pp. 187–194, fig. 3 references.

The Prandtl-Meyer "wedge solution" for the two-dimensional equations of motion of a compressible fluid, which is steady, irrotational, and isentropic, is generalized to include an expansion around any smooth or abrupt convex boundary. Taking into account the conditions of continuity, zero rotation, and Bernoulli's equation, the solution of equations for the most general type of motion in which the Cartesian components of velocity are each a function of fluid speed only, shows that the motion is necessarily supersonic, the lines of equal speed, pressure (isobars), and density are all straight lines, although not necessarily concurrent as in the original Prandtl-Meyer theory, and the component of fluid velocity perpendicular to the isobar is equal to the local velocity of sound. The solution for flow past an arbitrary fixed boundary is obtained analytically.

Application of the W.K.B. Method to the Flow of a Compressible Fluid. I. Isao Imai. *Journal of Mathematics and Physics,* Vol. 28, No. 3, October, 1949, pp. 173–182. 12 references.

The W.K.B. method of quantum mechanics is used to examine the convergency of exact solutions of the differential equations of compressible flow. The fundamental equations of the hodograph method are expressed in terms of new variables suggested by the

W.K.B. method, and for subsonic flow past an obstacle, an approximate treatment is developed which is similar to the Kármán-Tsien method and is accurate near the critical Mach Number. In the supersonic case, the equations of motion in terms of the new variables give immediately the equations of the characteristics.

The Calculation of Supersonic Downwash Using Line Vortex Theory. Harold Mirels and Rudolph C. Haefeli. *Journal of the Aeronautical Sciences*, Vol. 17, No. 1, January, 1950, pp. 13–21, figs. 10 references.

Readers' Forum: On the Reduction of Unsteady Supersonic Flow Problems to Steady Flow Problems. John W. Miles. *Journal of the Aeronautical Sciences*, Vol. 17, No. 1, January, 1950, p. 64. 5 references.

Readers' Forum: Unsteady Flow Theory in Dynamic Stability. John W. Miles. *Journal of the Aeronautical Sciences*, Vol. 17, No. 1, January, 1950, pp. 62, 63. 8 references.

Monograph IV; Methods of Linearization in Compressible Flow. III—Prandtl-Glauert Method. F. E. Ehlers. *U.S., Air Force, Technical Report No. F-TR-1180C-ND*, February, 1948. 141 pp., diagrs., figs. 50 references.

The Method of Characteristics in Compressible Flow; Ib—Numerical Examples. J. S. Isenberg. *U.S., Air Force, Technical Report No. F-TR-1173C-ND*, December, 1947. 63 pp., figs. 17 references.

On Similarity Rules for Transonic Flows. Carl Kaplan. *U.S., N.A.C.A., Report No. 894*, 1948. 5 pp. 6 references. U.S. Govt. Printing Office, Washington. $0.10.

The Use of Source-Sink and Doublet Distributions Extended to the Solution of Boundary-Value Problems in Supersonic Flow. Max. A. Heaslet and Harvard Lomax. *U.S., N.A.C.A., Report No. 900*, 1948. 15 pp., illus., figs. 7 references. U.S. Govt. Printing Office, Washington. $0.15.

Viscosity and Other Physical Properties of Gases and Gas Mixtures. J. O. Hirschfelder, R. B. Bird, and Ellen L. Spotz. *American Society of Mechanical Engineers, Transactions*, Vol. 71, No. 8, November, 1949, pp. 921–937, figs. 30 references.

Teoria Del Perfil (Profile Theory). Gregorio Millan Barbany. *Ingenieria Aeronautica*, Vol. 1, No. 1, January–March, 1949, pp. 38–44, figs. 18 references.

The Distribution of Singular Shock Directions. T. Y. Thomas. *Journal of Mathematics and Physics*, Vol. 28, No. 3, October, 1949, pp. 153–172, figs. 5 references.

The Airflow Slide Rule. Lisbeth Crowell. *Aero Digest*, Vol. 59, No. 6, December, 1949, pp. 66, 76, 78, figs.

The instrument shows normal shock relations on the front face and isentropic airflow relations on the back. One sliding insert is calibrated for temperatures in degrees Kelvin, degrees Rankine, and velocities in f.p.s. and in m.p.h. The second insert is calibrated for pressures in lbs. per sq.in. absolute, and densities in slugs per cu. ft. Calibration was developed from the general relations and the Mach Number relations. All flow calculations within the range of Mach Number 0.5 to 5.0 can be made.

Application of the Electrical Analogy in Fluid Mechanics Research. Philip G. Hubbard. *Review of Scientific Instruments*, Vol. 20, No. 11, November, 1949, pp. 802–807, illus., diagrs., figs. 5 references.

The Shock Tube, A Facility for Investigations in Fluid Dynamics. Walker Bleakney, D. K. Weimer, and C. H. Fletcher. *Review of Scientific Instruments*, Vol. 20, No. 11, November, 1949, pp. 807–815, illus., diagrs., figs. 14 references.

INTERNAL FLOW

Interference Method for Obtaining the Potential Flow Past an Arbitrary Cascade of Airfoils. S. Katzoff, Robert S. Finn, and James C. Laurence. *U.S., N.A.C.A., Report No. 879*, 1947. 18 pp., figs. 14 references. U.S. Govt. Printing Office, Washington. $0.15.

Separation of a Gas Mixture Flowing Through a Long Tube at Low Pressure. R. D. Present and A. J. deBethune. *U.S., Atomic Energy Commission, Document No. 2411* (Declassified December 14, 1948). 12 pp. 15 references. Document Sales Agency, Atomic Energy Commission, P.O. Box 62, Oak Ridge, Tenn. $0.10.

PERFORMANCE

The Pulse Method for the Determination of Aircraft Dynamic Performance. R. C. Seamans, Jr., B. P. Blasingame, and G. C. Clementson. *Journal of the Aeronautical Sciences*, Vol. 17, No. 1, January, 1950, pp. 22–38, diagrs., figs. 10 references.

Analysis of Means of Improving the Uncontrolled Lateral Motions of Personal Airplanes. Marion O. McKinney, Jr., *U.S., N.A.C.A., Technical Note No. 1997*, December, 1949. 28 pp., diagrs., figs. 4 references.

A Semiempirical Method for Estimating the Rolling Moment Due to Yawing of Airplanes. John P. Campbell and Alex Goodman. *U.S., N.A.C.A., Technical Note No. 1984*, December, 1949. 30 pp., figs. 3 references.

WINGS & AIRFOILS

Theory of the Oscillating Wing with Aerodynamically Balanced Control Surface in a Two-Dimensional, Subsonic, Compressible Flow. R. Timman and A. I. van de Vooren. *Netherlands, Nationaal Luchtvaartlaboratorium, Amsterdam, Rapport Nr. F.54*, June 15, 1949. 54 pp., fig. 18 references. (In English.)

A generalization of the Fourier series method used in the incompressible case which contains an extension of the theory to a wing including an aerodynamically balanced control surface. If the equations of motion are linearized by retaining only terms which are linear in the perturbation velocities, the equation for the acceleration potential of the oscillating airfoil in two-dimensional, subsonic, compressible flow can be reduced to the so-called wave equation of Pockels in two variables. When the oscillating potential is obtained, the pressure distribution on the ocsillating airfoil follows immediately, and the forces and moments on the wing and control surface then are obtained from integrals containing that pressure distribution. The linearization of the equations of motion requires that the airfoil be thin and that the dynamic angle of attack be small. Results are given in a form suitable for numerical computation.

The Theoretical Lateral-Stability Derivatives for Wings at Supersonic Speeds. Arthur L. Jones. *Journal of the Aeronautical Sciences*, Vol. 17, No. 1, January, 1950, pp. 39–46, 59, figs. 17 references.

Linearized Lifting-Surface Theory for Swept-Back Wings with Slender Plan Forms. Harvard Lomax and Max. A. Heaslet. *U.S., N.A.C.A., Technical Note No. 1992*, December, 1949. 41 pp., figs. 13 references.

Influence of Acceleration on Aerodynamic Characteristics of Thin Airfoils in Supersonic and Transonic Flight. C. S. Gardner and H. F. Ludloff. *Journal of the Aeronautical Sciences*, Vol. 17, No. 1, January, 1950, pp. 47–59, figs. 6 references.

Disturbed Motion of Air Caused by Vibrations of a Wing Moving at Supersonic Speed. E. A. Krasilschikova. (*Prikladnaia Matematika i Mekhanika* (U.S.S.R.), Vol. 11, 1947, pp. 147–164.) *U.S., Air Force, Technical Report No. 102-AC49/4-34*, December, 1949. 39 pp., figs. 15 references.

Theoretical Loading at Supersonic Speeds of Flat Swept-Back Wings with Interacting Trailing and Leading Edges. Doris Cohen. *U.S., N.A.C.A., Technical Note No. 1991*, December, 1949. 55 pp., diagrs. 6 references.

The Drag of a Delta Wing in Supersonic Flow. E. A. Karpovich and F. I. Frankl. (*Prikladnaia Matematika i Mekhanika* (*U.S.S.R.*), Vol. 11, 1947, pp. 495, 496.) *U.S., Air Force, Technical Report No. 102-AC49/3-34*, December, 1949. 6 pp., figs. 3 references.

Aerodynamic Characteristics of the NACA 8-H-12 Airfoil Section of Six Reynolds Numbers from 1.8×10^6 to 11.0×10^6. Raymond F. Schaefer and Hamilton A. Smith. *U.S., N.A.C.A., Technical Note No. 1998*, December, 1949. 12 pp., figs. 6 references.

Supersonic Flow Past Airfoil Tips. Leon Beskin. *Journal of Applied Mechanics*, Vol. 16, No. 4, December, 1949, pp. 329–345, figs. 10 references.

Air Transportation (41)

Inter-City Transport Development on the Commonwealth Routes. E. H. Atkin. *Royal Aeronautical Society, Journal*, Vol. 53, No. 467, November, 1949, pp. 1017–1040, diagrs., figs. 4 references.

A detailed survey of air-transport operations on internal routes in Europe, Australia, India, South Africa, Canada, and the United States, with particular reference to flight stages of from 250 to 1,000 miles. Such routes favor the use of advanced designs of turbine-propeller aircraft with cruising speeds of 300 to 350 m.p.h., and turbine-jet aircraft of 400 to 500 m.p.h. performance. Tabu-

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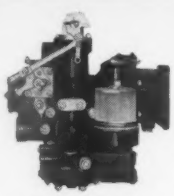
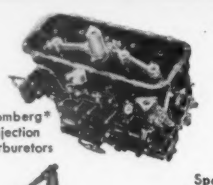


Fuel Metering Unit for jet engines



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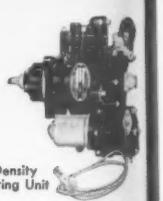

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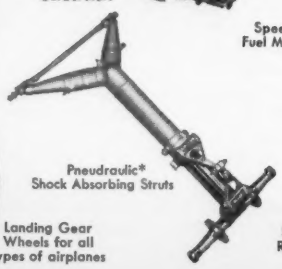

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lated operational analyses of typical air routes show that the requirements of flight duration, traffic, take-off and landing distances, runways, fuel allowances, alternate airports, and weather are within the performance abilities of modern aircraft. Airplanes of 40- to 60-passenger capacity and of 40,000 to 60,000 lbs. total weight are recommended because that size, larger than the minimum size for the routes, permits greater fuel allowances for stacking or to reach alternate airports, and gives better operating economy. Turbine-propeller and turbine-jet aircraft that are now in the development stage are economically competitive with current piston-engine aircraft. With the improvements constantly being made in turbine engines their advantage will increase. Consolidated direct and indirect costs show the superiority of jet power. Replacement of current equipment by turboprop and turbo-jet aircraft will call for improved methods of airline and airport traffic control. A period of experimental operation will be required, for which the British Commonwealth and Empire air routes are well suited because of the basic simplicity of the systems, adequate traffic volume, and the absence of frequent international frontiers and language problems.

Air Lines of the World. *The Aeroplane*, Vol. 77, No. 2007, November 25, 1949, p. 701, illus. A survey.

Philippine Air Lines. *Air World*, Vol. 2, No. 3, November, 1949, pp. 58–61, illus.

The Air Empire of Juan Trippe. Stanley Brogden. *Aircraft*, Vol. 28, No. 1, October, 1949, pp. 14–18, illus.

Canada's Expanding Aviation Industries. *The Aeroplane*, Vol. 77, No. 2006, November 18, 1949, pp. 664, 665, illus.

The Air Freight Forwarder is Your Traffic Department. Paul Rennell. *Air Transportation*, Vol. 15, No. 6, December, 1949, p. 10.

The Airborne Magnetometer in Canada. J. M. Bridgman. *Air World*, Vol. 2, No. 3, November, 1949, pp. 73–76, illus.

French Air Power Regains Altitude; French Use Interim Planes, Stress Training, Rely on Aircraft Industry. William Green. *Canadian Aviation*, Vol. 22, No. 12, December, 1949, pp. 24, 25, 50, illus.

California's Proposed Crop-Dusting Regulations. *Aero Digest*, Vol. 59, No. 6, December, 1949, pp. 21, 120, 121, illus.

Jet Deal Sparks Italy's Comeback. *Aviation Week*, Vol. 51, No. 25, December 19, 1949, p. 31, illus.

Airplane Design & Description (10)

AIRPLANE DESCRIPTIONS

Collecting a (Boeing) Stratocruiser; Air and Ground Training for the Crews, The Dehmel Synthetic Trainer, Flight Instructions, Loading Up and Cockpit Checks. II. *Flight*, Vol. 56, No. 2137, December 8, 1949, pp. 735–740, illus.

Designed for Cargo (Chase Aircraft XC-123, Avitruc). *Air Transportation*, Vol. 15, No. 6, December, 1949, pp. 17, 34, 35, illus.

British Bid in Lightplane Market (Chrislea Skyjeep). *Aviation Week*, Vol. 51, No. 24, December 12, 1949, p. 18, illus.

Chrislea's New Skyjeep. (Chrislea Aircraft Company, Ltd.) *The Aeroplane*, Vol. 77, No. 2008, December 2, 1949, pp. 768, 769, illus., cutaway drawing.

C.A.S.A.—201 "Alcotán." (Construcciones Aeronauticas, S.A.) Pedro Huarte-Mendicoa. *Ingenieria Aeronautica*, Vol. 1, No. 2, April-June, 1949, pp. 43–55, illus., diagrs., figs.

Detailed Data on (de Havilland) Comet Revealed. Robert B. Hotz. *Aviation Week*, Vol. 51, No. 21, November 21, 1949, pp. 16, 17, diagrs.

The New V.R. Trainer; Service Version of the (de Havilland) Chipmunk. *Flight*, Vol. 56, No. 2136, December 1, 1949, pp. 710–712, illus.

The Chipmunk (T Mk. 10, de Havilland) R.A.F.V.R. Trainer. *The Aeroplane*, Vol. 77, No. 2008, December 2, 1949, pp. 754–757, illus, diagrs., cutaway drawing.

Evolution for Cargo (Douglas DC-6A, Liftmaster). E. F. Burton. *Aero Digest*, Vol. 59, No. 6, December, 1949, pp. 48–50, 122, illus., figs.

Douglas Unveils the Giant 175,000 Pound C-124 Globemaster II. *Western Flying*, Vol. 29, No. 12, December, 1949, pp. 17, 18, illus.

Engineering the Douglas Super DC-3. M. K. Oleson. *Western Flying*, Vol. 29, No. 12, December, 1949, pp. 10, 11, illus.

The "Canberra" (English Electric Company, Ltd.) Jet Bomber. *The Engineer*, Vol. 188, No. 4897, December 2, 1949, pp. 649–651, illus., diagr.

Getting to Know the Canberra; English Electric's Twin-Avon Bomber Under Construction and on Test. *Flight*, Vol. 56, No. 2136, December 1, 1949, pp. 700, 701, illus.

Details of Britain's First Jet Bomber (English Electric Company Ltd., Al, Canberra B. Mk.1). *The Aeroplane*, Vol. 77, No. 2008, December 2, 1949, pp. 748, 749, diagr.

Canberra; Design Analysis of Britain's First Jet Bomber. (English Electric Company, Ltd.) *Flight*, Vol. 56, No. 2138, December 15, 1949, pp. 765–772, illus., diagrs., cutaway drawing.

Mainly on Flying the (Gloster) Meteor 7. R. G. Worcester. *The Aeroplane*, Vol. 77, No. 2005, November 11, 1949, pp. 644–648, illus., figs.

Novel Formula (The Lanier Paraplane, Lanier Aircraft Corporation). *The Aeroplane*, Vol. 77, No. 2006, November 18, 1949, pp. 674, 675, illus.

Short-Mayo "Composite" Recalled; French Research Aircraft (Leduc 0.10) Air Launched from Languedoc. *Flight*, Vol. 56, No. 2139, December 22, 1949, pp. 796, 797, illus.

XF-85 (McDonnell) Landing-Skid Development. John H. Meyer. *Aero Digest*, Vol. 59, No. 6, December, 1949, pp. 42, 43, 113, 114, illus., diagr.

Pilot's Report—Meyers 125 (Meyers Aircraft Company). Don Downie. *Skyways*, Vol. 8, No. 12, December, 1949, pp. 16–18, 56, 57, 59, illus.

Design Highlights of North American F-86. Robert McLarren. *Aviation Week*, Vol. 51, No. 21, November 21, 1949, pp. 18, 20, 22, 24–26, illus.

Aircraft Engineering Reference Sheet. V—Percival Proctor. (Percival Aircraft, Ltd.) T. Tonkin. *Aircraft Engineering*, Vol. 21, No. 250, December, 1949, pp. 391–394, diagrs.

Our Largest Military Aircraft (Avro Shackleton). *The Aeroplane*, Vol. 77, No. 2009, December 9, 1949, pp. 788–792, illus., cutaway drawing.

Canada Develops Jetliner (Avro C-102). Walter N. Deisher. *SAE Journal*, Vol. 57, No. 12, December, 1949, pp. 17, 18, illus. (Extended summary of a paper.)

Avro (A. V. Roe Canada, Ltd.) Orenda; Canada's Second Turbojet. *Flight*, Vol. 56, No. 2136, December 1, 1949, p. 709, illus.

Flying the (Avro) Athena (2). R. G. Worcester. *The Aeroplane*, Vol. 77, No. 2006, November 18, 1949, pp. 676–678, illus., fig.

Een Belgisch Success; De Stampe-Vertongen SV-4 [A Belgian Success; The Stampe-Ventogen SV-4 (Société Stampe et Renard)] Vliegwereld, Vol. 15, No. 38, September 22, 1949, p. 626, illus.

Britain's First "All-Swept" Aircraft. *The Aeroplane*, Vol. 77, No. 2010, December 16, 1949, pp. 816–819, illus., cutaway drawing. Details of the Supermarine 510, an experimental version of the E 10/44, Vickers-Armstrongs, Ltd.

Flying the (Vickers) Viscount. R. G. Worcester. *The Aeroplane*, Vol. 77, No. 2004, November 4, 1949, pp. 618–620, illus.

The Prestwick Controversy; Ministers' Statements in the Lords and Commons, Opposition Dissatisfaction. *Flight*, Vol. 56, No. 2137, December 8, 1949, p. 748. Brown and Dureau, Australia.

Fighting Planes of the RAF. *Skyways*, Vol. 8, No. 12, December, 1949, pp. 33–43, illus.

Jets—U.K. vs. U.S. N. F. Silsbee. *Skyways*, Vol. 8, No. 12, December, 1949, pp. 14, 15, 52, 55, illus.

What's in a Name? D. A. S. McKay. *Aeronautics*, Vol. 22, No. 1, December, 1949, pp. 36–39.

The derivation and significance of the symbols used for designating commercial and military aircraft in Great Britain, Denmark, France, Germany, Holland, Italy, Japan, Russia, Sweden, and the United States.

Predictions of Supersonic Airplane Performance. Harold Luskin. *Journal of the Aeronautical Sciences*, Vol. 17, No. 1, January, 1950, pp. 5–12, figs. 18 references.

Russia's Rocket Fighter. John T. Dodson. *Flying*, Vol. 46, No. 1, January, 1950, pp. 13–15, illus., diagr.

LANDING GEAR

Coefficients of Friction. E. C. Pike. *Royal Aeronautical Society, Journal*, Vol. 53, No. 468, December, 1949, pp. 1085–1094, figs. 10 references.

Summary of information about rolling and sliding coefficients of friction between rubber tires and road or runway surfaces, which is based largely on tests of automobile tires at speeds up to 40 m.p.h. One American test was at 110 m.p.h. and some British estimates were up to 120 m.p.h. For sliding friction coefficients, differences in surface texture as distinct from surface material are significant, but information about braking force coefficient can be given only in the form of limits within which mean values would give satisfactory estimates. The variation of rolling resistance coefficient with speed is small, and its effect on take-off run is slight.

Brake Brain. *Aero Digest*, Vol. 59, No. 6, December, 1949, pp. 32, 82, illus. The "Hytrol" brake-control system incorporates a rotary inertia skid-detector mechanism that detects angular deceleration of the wheel.

Stop that Skid. *Aviation Operations*, Vol. 12, No. 5, November, 1949, pp. 43, 66, illus.

A rotary inertia detector mechanism fitting into the main landing wheel axle acts upon the angular deceleration of the wheel just before the incipient skid condition, by energizing a solenoid controlling a hydraulic release valve which automatically reduces the braking pressure. When the wheel recovers synchronous speed the detector signal de-energizes the solenoid, thus restoring the brake pressure to the control of the pilot.

Practice of Shock-Absorber Design; Steps in the Design of an Oleo-Pneumatic Undercarriage Leg. F. E. Burger. *Aircraft Engineering*, Vol. 21, No. 250, December, 1949, pp. 384, 385, illus., figs. 2 references.

Flight Tests on Undercarriage Loads for a Single-Engined Aircraft Equipped with Skis. A. D. Wood. *Canada, National Research Council, Division of Mechanical Engineering, Report No. MR-7*, June 16, 1949. 46 pp., illus., figs. 3 references.

PRELIMINARY DESIGN

Weight and Design. L. W. Rosenthal. *Flight*, Vol. 56, No. 2139, December 22, 1949, pp. 802–804, figs. (Extended summary of a paper.)

How to Make Military & Commercial Transports Interchangeable. Wellwood E. Beall, George W. Haldeman, W. W. Davies, and Laurence S. Kuter. *SAE Journal*, Vol. 57, No. 12, December, 1949, pp. 32–35. (Summary of a panel discussion: Interchangeability of Military and Commercial Transports.)

Aerodynamic Cleanness. *Flight*, Vol. 56, No. 2137, December 8, 1949, pp. 743–747, figs.

WING GROUP

Ambassador Progress; Testing of Wing Structure and Pressurization, Engine Development. *Flight*, Vol. 56, No. 2138, December 15, 1949, p. 759, illus.

Airports & Airways (39)

Air Carriers and Use Fees. Kenneth A. Osterberg. *Aviation Operations*, Vol. 12, No. 5, November, 1949, pp. 31, 70, 71, illus.

Lockheed Reveals Results of 3-Year Terminal Study. *American Aviation*, Vol. 13, No. 14, December 15, 1949, pp. 53, 54, diagrs.

Airports Need Radiant Heating. Frank H. Slade. *Airport & Air Transportation*, Vol. 4, No. 77, November, 1949, pp. 267–270, illus., diagr.

Protection of Aircraft Hangars and their Contents from Fire. *National Fire Protection Association, Committee on Aviation and Airport Fire Protection, Bulletin No. 25-A*, November, 1949. 6 pp.

Air Traffic Control Faces the Jet Era. Don Anderson. *Aircraft*, Vol. 28, No. 1, October, 1949, pp. 12, 13, 36, 38, illus.

The Slope Line System of Approach Lighting. W. D. Perreault. *Shell Aviation News*, No. 136, October, 1949, pp. 8–10, illus., figs.

Radar Development. *The Aeroplane*, Vol. 77, No. 2004, November 4, 1949, p. 610, illus.

A new responder beacon designed by Flight Refuelling, Ltd. is primarily intended for air-borne application, but it is also suitable for airport use. In air-to-air tests ranges of 150 miles have been achieved.

Radio Flight. Sandy A. F. MacDonald. *Canadian Aviation*, Vol. 22, No. 12, December, 1949, pp. 36, 38, 40, figs.

Airport and Radio Equipment. *The Aeroplane*, Vol. 77, No. 2008, November 25, 1949, pp. 733–738, illus. A survey.

Why High Intensity Runway Lights? Leslie C. Vipond. *Aviation Operations*, Vol. 12, No. 6, December, 1949, pp. 40, 68, 69, illus.

Winterize Those Lights. Leslie C. Vipond. *Aviation Operations*, Vol. 12, No. 5, November, 1949, pp. 46, 68, 69, illus.

Golden Gateway. Kenneth R. MacDonald. *Aero Digest*, Vol. 59, No. 6, December, 1949, pp. 60, 61, 80, 94–96, illus., figs. Report on facilities for commercial and private aviation in the San Francisco Bay area.

International Airports at Paris, Le Bourget and Orly. *The Aeroplane*, Vol. 77, No. 2007, November 25, 1949, pp. 711–714, illus.

Land and Water Air Base; Progress at Egypt's Fuad 1 Airport. *Flight*, Vol. 56, No. 2137, December 8, 1949, p. 728, diagr.

Augusta; Flying-Boat Port of Call in Sicily. *Airports & Air Transportation*, Vol. 4, No. 77, November, 1949, pp. 275–279, illus.

Finnish Air Transport. II—Aerodromes and Control Organisation. *Modern Transport*, Vol. 62, No. 1599, November 19, 1949, p. 11, illus.

Luchthaven Schiphol (Schiphol Airport). *De Vliegende Hollander*, Vol. 5, No. 9, September, 1949, pp. 216–218, diagrs.

El Aeropuerto de Guinea (The Airport of Guinea). A. Vizcaino and R. Tatay. *Revista de Aeronautica* Vol. 8, No. 95, October, 1948, pp. 775–778, illus., figs.

Radiofaro Sol (Radio Beacon "Sol"). Carlos Gorozarri Puente. *Ingenieria Aeronautica*, Vol. 1, No. 2, April-June, 1949, pp. 29–42, illus., diagrs., figs.

Aviation Medicine (19)

In-Flight Activities of Navigators in the Atlantic and Pacific Areas. Julien M. Christensen. *U.S., Air Force, Technical Report No. 5571*, October, 1949. 17 pp., illus., figs. 4 references.

Studies Pertaining to the Design of Visual Displays for Aircraft Instruments, Computers, Maps, Charts, Tables and Graphs; A Review of the Literature. *U.S., Air Force, Technical Report No. 5765* (ATI No. 55956), April, 1949. 100 pp., figs. 344 references.

Eye Fixations of Aircraft Pilots. I—A Review of Prior Eye-Movement Studies and a Description of a Technique for Recording the Frequency, Duration, and Sequences of Eye Fixations During Instrument Flight. Richard E. Jones, John L. Milton, and Paul M. Fitts. *U.S., Air Force, Technical Report No. 5837*, September, 1949. 27 pp., illus., diagrs., figs. 49 references.

Speed and Accuracy of Readings as a Function of Design in the Sensitive Airspeed Indicator. George E. Long. *U.S., Air Force, Technical Report No. 5836*, August, 1949. 13 pp., figs. 7 references.

Flying with Contact Lenses. *The Aeroplane*, Vol. 77, No. 2004, November 4, 1949, pp. 614, 615, illus.

Insulating Cloth for Cold-Weather Clothing. William O. Perry. *U.S., Central Air Documents Office (Navy-Air Force), Technical Data Digest*, Vol. 14, No. 23, December 1, 1949, pp. 13–19, illus., figs.

La Seleccion de Pilotos Desde el Punto de Vista Psicologico (Pilot Selection from Point of View of the Psychologist). Manuel Nunez Garcia. *Revista de Aeronautica*, Vol. 8, No. 94, September, 1948, pp. 701–704.

Comfortization (23)

New Cabin Blower for Convairs. *Aviation Week*, Vol. 51, No. 21, November 21, 1949, pp. 37, 38, illus.

The Stratos supercharger for cabin pressurization is mounted directly on one of the engines, just forward of the firewall, and operates without the drive shafts or hydraulic mechanisms characteristic of earlier systems. Savings are expected in weight, time, and material costs.

Some Aspects of Passenger Comfort in Aircraft. J. W. S. Brancker. *Airports & Air Transportation*, Vol. 4, No. 77, November, 1949, pp. 271, 272, 270. (Extended summary of a paper.)

Electronics (3)

Path Rainfall and the Attenuation of Microwaves. *U.S., National Bureau of Standards, Technical Report No. 1385*, November, 1949. 5 pp.

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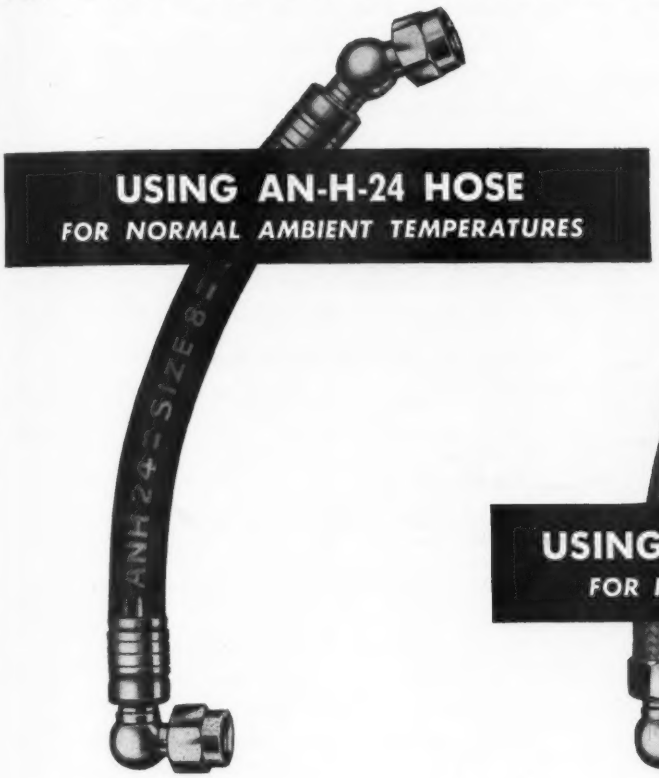

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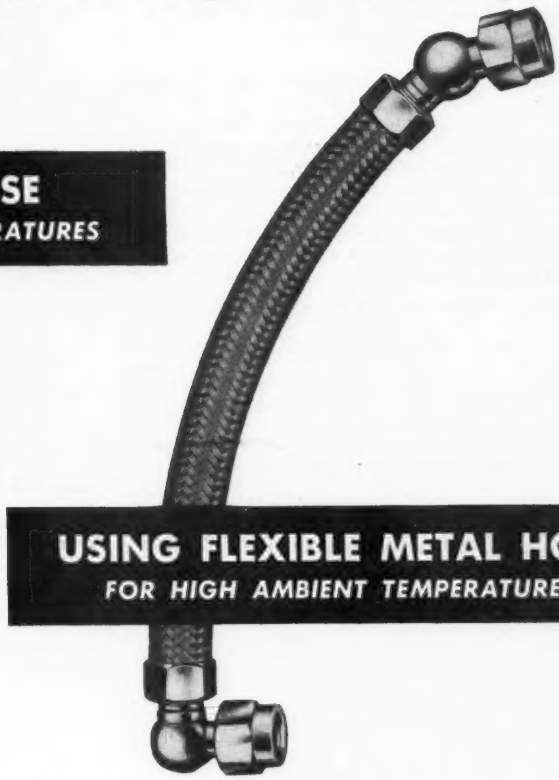

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What Does Rain Do to Radar? Robert McLarren. *Aviation Week*, Vol. 51, No. 24, December, 1949, pp. 21, 22, 24, fig. 9 references.

G.E.C. VHF Transmitter/Receiver (BRT-600) for Aircraft. *Airport & Air Transportation*, Vol. 4, No. 77, November, 1949, p. 280, illus.

Thin Crystal Problems Solved. *Aviation Week*, Vol. 51, No. 26, December 26, 1949, pp. 25, 26, illus.

New crystal-grinding apparatus developed at the National Bureau of Standards uses an improved form of the square block and cell method. It facilitates production of quartz crystals of 0.001-in. thickness.

Crystal Control at 1000 Megacycles for Aerial Navigation. S. H. Dodington. *Electrical Communication*, Vol. 26, No. 4, December, 1949, pp. 272–278, illus., diagrs. 1 reference.

An Electronic DC to AC Converter for Use in Servo Systems. E. E. St. John. *Institute of Radio Engineers, Proceedings*, Vol. 37, No. 12, December, 1949, Waves and Electrons Section, pp. 1474–1478, diagrs., figs. 2 references.

Applications of Network Theorems in Transient Analysis. Y. P. Yu. *Franklin Institute, Journal*, Vol. 248, No. 5, November, 1949, pp. 381–398, figs. 2 references.

Physical Characteristics of a Sonic Interferometer. N. Underwood, T. V. Blosser, and R. R. Feezell. *U.S., Atomic Energy Commission, Document No. 2354*, August 24, 1948 (Declassified October 20, 1948). 19 pp., diagrs., figs. 15 references. Document Sales Agency, Atomic Energy Commission, P O. Box 62, Oak Ridge, Tenn. $0.10.

Engineering Practices (49)

An Analogue Computer for the Solution of Linear Simultaneous Equations. Robert M. Walker. *Institute of Radio Engineers, Proceedings*, Vol. 37, No. 12, December, 1949, Waves and Electrons Section, pp. 1467–1473, illus., diagrs. 5 references.

Equipment

HYDRAULIC & PNEUMATIC (20)

A Practical Study of the Compressibility of Air for Aircraft Equipment Design. H. E. Heigis. *Aero Digest*, Vol. 59, No. 6, December, 1949, pp. 37, 120.

Auxiliary Gas Turbines for Pneumatic Power in Aircraft Applications. H. J. Wood and F. Dallenbach. *Automotive Industries*, Vol. 101, No. 12, December 15, 1949, pp. 36, 37, 78, illus., diagrs.

Hydraulic Shock Absorbers. Victor Tatarinov. *Product Engineering*, Vol. 20, No. 12, December, 1949, pp. 140–142, figs.

Mechanisms Actuated by Air or Hydraulic Cylinders. *Product Engineering*, Vol. 20, No. 12, December, 1949, pp. 128, 129, diagrs.

Flight Operating Problems (31)

CRUISE CONTROL

How to Use the Sequence Report. Robert W. Mudge. *Air Facts*, Vol. 12, No. 12, December 1, 1949, pp. 24–32.

HIGH-ALTITUDE FLIGHT

Sonic Speed. C. H. Cotton. *Canadian Aviation*, Vol. 22, No. 12, December, 1949, pp. 28, 30, 32, 42–44, figs.

HIGH-SPEED FLIGHT

High Flight. W. A. Waterton. *Canadian Aviation*, Vol. 22, No. 12, December, 1949, pp. 23, 46, 48, illus.

ICE PREVENTION & REMOVAL

Intermittent Heating for Protection in Aircraft Icing. Myron Tribus. *California, University, Department of Engineering, Doctoral Thesis*, September, 1949. 83 pp., illus., diagrs., figs. 39 references.

The energy requirements for removal of ice formed on intermittently heated surfaces vary with the shape and size of the surface, speed, temperature, and moisture content of the air, droplet sizes, heat-transfer and evaporation rates, kinetic heating by the air, and the internal construction of the aircraft component. Equations based on those variables are solved by means of a specially designed nonlinear electrical circuit that has properties analogous to those of the thermal circuit. Solutions, when compared with actual temperatures of heated and unheated propeller blades under icing conditions, show good agreement between prediction and measurement. Energy requirements decrease instead of increase with an increasing ice-accretion rate, because of the heat of fusion. This result, however, does not apply when continuous heating is used. Two-thirds of the energy from the heaters currently used on propeller blades is wasted in the blade and is not available for melting ice.

PILOTING TECHNIQUE

Safety in Standing Waves. J. C. Neilan. *The Aeroplane*, Vol. 77, No. 2006, November 18, 1949, pp. 669, 670, illus., figs.

WEATHER HAZARDS

Aircraft Operation in Natural Icing Conditions. James L. Murray. *U.S., Central Air Documents Office (Navy-Air Force), Technical Data Digest*, Vol. 14, No. 24, December 15, 1949, pp. 12–18, illus., figs 6 references.

Flight Safety & Rescue (15)

CAA Intensifies Fire-Prevention Research. *Aviation Week*, Vol. 51, No. 21, November 21, 1949, pp. 27, 28, illus.

Problems of Offshore Rescue. Jerome Lederer. *Aero Digest*, Vol. 59, No. 6, December, 1949, pp. 70, 103, illus.

The Fire Risk in Aircraft. W. O. Manning. *Aeronautics*, Vol. 22, No. 1, December, 1949, p. 45.

Control of Landing Gear Fires on the Ground. *National Fire Protection Association, Committee on Aviation and Airport Fire Protection, Bulletin No. 39*, November, 1949. 2 pp.

The Use of Carbon Dioxide Gas on Transparent Plastic Panels for Forceable Entry into Crashed Aircraft. *National Fire Protection Association, Committee on Aviation and Airport Fire Protection, Bulletin No. 38*, November, 1949. 3 pp.

Flight Testing (13)

Torch in the Sky; Purpose and Practice of the Empire Test Pilots' School. C. B. Bailey-Watson. *Flight*, Vol. 56, No. 2136, December 1, 1949, pp. 705–708, illus.

Fuels & Lubricants (12)

Stability of Concentrated Hydrogen Peroxide Solutions. Walter C. Schumb. *Industrial and Engineering Chemistry*, Vol. 41, No. 5, May, 1949, pp. 992–1003, diagr., figs. 22 references.

Concentrated hydrogen peroxide solutions ranging from 70 to 90 weight per cent were studied for stability characteristics at 50° to 100°C., with and without stabilizers. The 50° temperature proved satisfactory for the gas evolution method used to determine the rate of decomposition, confirming previous reports of high stability of pure hydrogen peroxide at concentrations of 85 to 90 per cent. The temperature coefficient of the decomposition rate of unstabilized peroxide solutions was established at 2.2 ± 0.1 for temperatures ranging from 50° to 70°C., which is approximately applicable over any 10° range between 50° and 100°C. Surface-preparation methods developed for Pyrex containers made it possible to obtain reproducible measurements of the decomposition rate. Pure aluminum and pure cast tin also were found suitable for use as containers after proper surface preparation. Vigorous agitation had no appreciable effect on the measured decomposition rate of 85 per cent unstabilized hydrogen peroxide. The importance of pH on the decomposition rate was emphasized by measurements with and without added catalytic

ions. Data were obtained on the catalytic effect of known concentrations of ferric or cupric ion in 85 to 90 per cent hydrogen peroxide at 50 °C. and on the required concentrations of stabilizers to restrain such catalytic action.

Application of Radioactive Tracers to Improvement of Fuels, Lubricants, and Engines. P. L. Pinotti, D. E. Hull, and E. J. McLaughlin. *SAE Quarterly Transactions*, Vol. 3, No. 4. October, 1949, pp. 634–638, illus., figs. 1 reference.

Oxidation Stability of Tetraethyllead and Leaded Aviation Gasolines. E. L. Walters and C. J. Busso. *Industrial and Engineering Chemistry*, Vol. 41, No. 5, May, 1949, pp. 907–914, figs. 11 references. (Additives for Petroleum Symposium.)

Typical aviation gasoline base stocks were stable initially, but were rendered unstable by the addition of tetraethyllead. The effects of tetraethyllead were pronounced in concentrations above 1 ml. per gallon and persisted in finished blends containing conventional amounts of reactive hydrocarbons (olefins and aromatics) and inhibitors. Further study indicated that tetraethyllead itself was extremely unstable towards oxidation. Tetraethyllead and leaded aviation gasolines respond similarly to inhibition, although maximum stability levels are lower for tetraethyllead. Preoxidation of tetraethyllead prior to gasoline blending may adversely affect stability and inhibitor susceptibility of leaded gasoline.

Antiknock Agents. H. A. Beatty and W. G. Lovell. *Industrial and Engineering Chemistry*, Vol. 41, No. 5, May, 1949, pp. 886–888. 2 references. (Additives for Petroleum Symposium.)

Utilization of 2,2-Dinitropropane as a Cetane Number Improver. R. E. Albright, F. L. Nelson, and L. Raymond. *Industrial and Engineering Chemistry*, Vol. 41, No. 5, May, 1949, pp. 929–934, fig. 9 references. (Additives for Petroleum Symposium.)

Sulfur-Tetraethyllead Interaction in Motor Fuels. H. K. Livingston. *Industrial and Engineering Chemistry*, Vol. 41, No. 5, May, 1949, pp. 888–893, figs. 11 references. (Additives for Petroleum Symposium.)

Effect of Additives on Gasoline Engine Deposits. R. E. Albright, F. L. Nelson, and L. Raymond. *Industrial and Engineering Chemistry*, Vol. 41, No. 5, May, 1949, pp. 897–902, illus., figs. 8 references. (Additives for Petroleum Symposium.)

Inhibitor Concentration and Stability. R. H. Rosenwald and J. R. Hoatson. *Industrial and Engineering Chemistry*, Vol. 41, No. 5, May, 1949, pp. 914–918, figs. 4 references. (Additives for Petroleum Symposium.)

The relation between the extent of stabilization as measured by the accelerated oxygen bomb and inhibitor concentration can be expressed by two general equations in which the two variables are the length of the induction period and the inhibitor concentration. The applicability of the two equations is demonstrated for thermally cracked and catalytically cracked gasolines with four antioxidants.

Factors Affecting Octane-Number Requirement. Harold J. Gibson. *SAE Quarterly Transactions*, Vol. 3, No. 4, October, 1949, pp. 557–570, figs. 4 references.

Combustion of Hydrocarbons; Free Radical Chain Reactions. Paul L. Cramer and John M. Campbell. *Industrial and Engineering Chemistry*, Vol. 41, No. 5, May, 1949, pp. 893–897, figs. 12 references. (Additives for Petroleum Symposium.)

Graphite Lubricates Aircraft Parts. James Joseph. *Aviation Operations*, Vol. 12, No. 6, December, 1949, pp. 34, 55, illus.

The Lubrication Requirements of the Modern Aircraft. E. O. Petzold. *Air World*, Vol. 2, No. 3, November, 1949, pp. 62–67, illus., diagrs.

A New Outlook on Lubrication. Edward A. Smith. *Aeronautics*, Vol. 22, No. 1, December, 1949, pp. 61, 63, figs. Reports on recent revisions of accepted theories about oil films, rubbing surfaces, and the chemical actions taking place in lubrication.

Antiseizure Properties of Boundary Lubricants. R. E. Thorpe and R. G. Larsen. *Industrial and Engineering Chemistry*, Vol. 41, No. 5, May, 1949, pp. 938–943, illus., figs. 15 references. (Additives for Petroleum Symposium.)

Various modifications of the four-ball wear apparatus were used to study the variations with speed of the coefficient of friction of boundary lubricants in which the antiseizure properties usually depend upon shearing of tightly bound films chemically formed in place on the rubbing surfaces. In effective boundary lubricants, at low speeds, ranging from 0.1 to 8 cm. per sec., friction is independent of sliding velocity, or it decreases slightly as the speed approaches zero. Conversely, poor boundary lubricants containing no polar constituents or, polar molecules capable of physical adsorption only, are characterized by relatively high friction. In that case the friction often increases at low sliding velocities to values typical of unlubricated surfaces. Effective boundary lubrication reduces the degree of metal-to-metal contact to small values. The actual magnitude of the coefficient of friction under nonseizing conditions is determined to a considerable extent by the thicknesses of adsorbed films which the lubricant can maintain.

Oxidation of Lubricating Oils at High Temperatures. G. H. Denison and O. L. Harle. *Industrial and Engineering Chemistry*, Vol. 41, No. 5, May, 1949, pp. 934–937, figs. 13 references. (Additives for Petroleum Symposium.)

Laboratory investigations of oil oxidation are usually performed at approximately 170 °C., corresponding to the temperature prevailing at the bearings and in crankcases of internal-combustion engines. To extend such studies to temperatures prevalent in the piston-ring zone, techniques were developed for determining the oxygen-absorption rates at temperatures as high as 340 °C. The absorption rates over the range 170 ° to 340 °C. obey the Arrhenius law within the limits of accuracy of the present experimental method. In general, at piston-area temperature of 290 °C. and engine-sump temperature of 90 °C., and with other rate-controlling factors being equal, the overall oxidation rate in the piston area is 200,000 times more rapid. All the oils tested show experimental activation energy values for the initial step of oxidation which average about 33 kg.-cal. This is in agreement with values given in other experiments for reactions performed at lower temperatures.

Stability Test for Additive-Treated Motor Oils. S. A. McKee and Ann Robinson Fritz. *Analytical Chemistry*, Vol. 21, No. 5, May, 1949, pp. 568–572, illus. 5 references.

Viscosity, Temperature, and Pressure of Lubricating Oils. R. T. Sanderson. *Industrial and Engineering Chemistry*, Vol. 41, No. 9, September, 1949, pp. 2059–2061, fig. 9 references.

An exact equivalence between compression at 100 °F. and cooling at 1 atmosphere pressure, in their effect on the kinematic viscosity of some pure hydrocarbons in the light-lubricating oil range, has been found and evaluated quantitatively as a linear relation between $P^{1/2}$ and log T. Data are not yet available for thorough evaluation of the applicability to petroleum lubricating oils, but it appears possible to predict at least approximately, the effect of pressure on their kinematic viscosity from a knowledge of their viscosity-temperature properties.

Representation of Viscosity-Temperature Characteristics of Lubricating Oils. J. H. Ramser. *Industrial and Engineering Chemistry*, Vol. 41, No. 9, September, 1949, pp. 2053–2059. 14 references.

Mathematical reasoning on the basis of a general functional relation between viscosity and temperature shows that the viscosity index and the A.S.T.M. slope are not unique measures of the fractional change of viscosity with temperature, because the viscosity enters the derived relations as an independent variable. The properties of the average change of viscosity are computed over comparable sections of the viscosity-temperature curve and between constant-temperature limits. The point at which the curvature of the viscosity-temperature curve is at maximum is calculated for a wide range of oils, demonstrating that the absolute change of viscosity has a constant value at that maximum point. A new measure of viscosity-temperature characteristics, using the average fractional change of viscosity between suitable temperature limits, and called the "viscosity-temperature rating" is suggested for evaluation of oils under actual operating conditions.

Polymethacrylates as Viscosity Index Improvers and Pour Point Depressants. W. L. Van Horne. *Industrial and Engineering Chemistry*, Vol. 41, No. 5, May, 1949, pp. 952–959, figs. 24 references. (Additives for Petroleum Symposium.)

Synthetic polymeric materials for which the composition and molecular weight can be controlled appear to be well suited for use as so-called viscosity index improvers. Polymethacrylates are used to show the application of these polymeric materials in a number of lubricating stocks. The polymethacrylates also provide highly efficient pour point depressants for lubricating oils.

Complex Thiophosphoric Amides as Lubricant Additives. J. D. Bartleson and M. L. Sunday. *Industrial and Engineering Chemistry*, Vol. 41, No. 5, May, 1949, pp. 948–951, illus. 20 references. (Additives for Petroleum Symposium.)

Oxidation of Lubricating Oils; Dialkyl Selenides as Inhibitors. G. H. Denison and P. C. Condit. *Industrial and Engineering*

Chemistry, Vol. 41, No. 5, May, 1949, pp. 944–948, figs. 8 references. (Additives for Petroleum Symposium.)

Thermal Conductivity of Liquid Silicones. O. Kenneth Bates. *Industrial and Engineering Chemistry*, Vol. 41, No. 9, September, 1949, pp. 1966–1968, fig. 19 references.

The thermal conductivity and coefficient of thermal conductivity for nine liquid silicones of the homologous series of pure trimethyl end-blocked dimethyl siloxanes, ranging in viscosities from 0.65 to 12,500 cs. at 25°C., were determined experimentally. An empirical equation, relating the thermal conductivity as a function of the viscosity and temperature, is proposed for this series of polymers.

Calculating Pressure-Flow Relations for Lubricating Grease. J. W. Wilson and Gerould H. Smith. *Industrial and Engineering Chemistry*, Vol. 41, No. 4, April, 1949, pp. 770–776, figs. 12 references.

Extreme Temperature Lubricating Greases from Silicones and Silicone-Diester Mixtures. R. L. Merker and W. A. Zisman. *Industrial and Engineering Chemistry*, Vol. 41, No. 11, November, 1949, pp. 2546–2551, figs. 18 references.

New silicone-base lithium stearate greases offer valuable advantages for the lubrication of ball and roller bearings over a temperature range of −60° to 325°F. and appear to be uniquely suitable for elevated temperatures. In applications involving a wide temperature range and extremely low levels ranging from −130° to 250°F. the silicone-diester base lithium stearate greases are more suitable. Both classes have good stability with respect to heat, oxidation, and mechanical working.

Phase State and Thermal Transitions of Greases. M. J. Vold, G. S. Hattiangdi, and R. D. Vold. *Industrial and Engineering Chemistry*, Vol. 41, No. 11, November, 1949, pp. 2539–2546, figs. 24 references.

Studies are made of X-ray diffraction patterns at room temperature and of differential heating curves ranging from room temperature to the liquefaction point for numerous samples of aluminum, barium, calcium, lithium, sodium, and mixed-base commercial lubricating greases and for corresponding oil-free soaps. At room temperature the greases contain principally finely divided crystalline soap in oil, but the crystallites may be modified formation-in-place as compared with their structure when prepared in the oil-free state. Lithium soap crystallites are almost unaffected by formation-in-place as compared with their structure when prepared in the oil-free state. Lithium soap crystallites are almost unaffected by formation-in-place except in size, while greases stabilized with barium acetate contain crystallites of structure different from that of either soap or salt. Upon heating, the greases undergo thermal transformations of the oil-free soaps. In other cases more complex solubility relations exist, involving swelling of the soap to form liquid crystalline solutions of oil in soap.

Gliders (35)

On the Selection of Construction Materials. A. R. Weyl. *Sailplane and Glider*, Vol. 17, No. 11, November, 1949, pp. 253, 254.

New Canadian Sailplane; "The Loudon." W. Czerwinski. *Sailplane and Glider*, Vol. 17, No. 11, November, 1949, pp. 249, 250, figs.

3 Sensational Months for French Soaring, June, July and August, 1949. Guy Borgé. *Sailplane and Glider*, Vol. 17, No. 11, November, 1949, pp. 242, 243.

Guided Missiles (1)

A Heliographic Attitude Recorder for Missiles. W. B. Klemperer. *Navigation*, Vol. 2, No. 3, September, 1949, pp. 49–54, illus., diagrs.

To obtain pictures of the sun and horizon by means of missile-borne cameras despite any turns, twists, or tumbles of the missile in flight. An optical system comprising four single-element lenses was mounted in a collar in the nose cone of a rocket missile in such a way as to take four pictures each at a 90° angle from the other. The images were coordinated by a pyramid of mirror surfaces and photographed by motion-picture cameras. Housed in an armored case filled with silicone putty, the instruments and films could be recovered after falling as much as 100 miles. From those records of sun and horizon angles, the missile attitudes are computed in earth coordinates. The computation is facilitated by a spherical slide rule called an "armillary sphere" that simulates the missile attitude with respect to a horizon-coordinate system in which the true inclination, heading, and roll can be read directly, and from which the perspective or aspect history of the missile for any given observation station can be reconstructed.

The Research Scene. II. K. W. Gatland. *British Interplanetary Society, Journal*, Vol. 8, No. 5, September, 1949, pp. 193–197.

Description of the development of the A.4 rocket for high-altitude sounding, outlining the conditions governing the experiments, and listing the Government, educational, and industrial organizations participating in the research work.

The Rocket Plane. III. Hermann Oberth. (*Weg zur Raumschiffahrt*, Munich, 1929, pp. 286–295.) *Rocketscience*, Vol. 3, No. 4, December, 1949, pp. 77–80, figs.

Missiles for Outer Space. J. P. Field, Jr. *Antiaircraft Journal*, Vol. 92, No. 6, November-December, 1949, pp. 15–19, illus., figs. 2 references.

Astronomy and Astronautics. Michael W. Ovenden. *British Imterplanetary Society, Journal*, Vol. 8, No. 5, September, 1949, pp. 180–192, figs. 7 references.

Australia's Long-Range Weapons Range. S. A. Morrison. *Antiaircraft Journal*, Vol. 92, No. 6, November-December, 1949, pp. 40, 41.

Ryan Firebird. *Ryan Reporter*, Vol. 10, No. 9, December 6, 1949, pp. 10–13, 16, 17, illus. The XAAM-A-1, an experimental, air-to-air guided missile.

Instruments

AIRCRAFT (9)

Engine Analyzer Proved in Service. *Aviation Week*, Vol. 51, No. 25, December 19, 1949, pp. 35, 36, illus., diagr.

The Gullfinder. Justin Arthur. *Aircraft and Airport*, Vol. 11, No. 11, December, 1949, p. 10, illus.

Long-range radio telephone receiver and transmitter for sailplanes weighs only 9 lbs. and operates on 1-watt power supplied by dry batteries.

A New Instrument Mechanism. A. G. Stimson, F. B. Jennings, and C. W. McCarty. *Electrical Engineering*, Vol. 68, No. 12, December, 1949, p. 1058, diagrs.

Differs from conventional construction by having its magnetic material entirely within the locus of the moving coil, giving less size and weight, greater flux utilization, expanded scale distribution, and by being self shielding.

TEST & MEASURING

Transient Behavior of Lumped-Constant Systems for Sensing Gas Pressures. Gene J. Delio, Glennon V. Schwent, and Richard S. Cesaro. *U.S., N.A.C.A., Technical Note No. 1988*, December, 1949. 35 pp., illus., diagrs., figs. 11 references.

Electronic Tachometer Provides Accurate Speed Measurement. Walter Richter. *Machine Design*, Vol. 21, No. 11, November, 1949, pp. 133–136, illus., diagrs.

A Flowmeter for High Temperature Gases. E. W. Comings and R. C. Johnson. *Analytical Chemistry*, Vol. 21, No. 2, February, 1949, pp. 290–292, figs. 3 references.

An Absolute Noise Thermometer for High Temperatures and High Pressures. J. B. Garrison and A. W. Lawson. *Review of Scientific Instruments*, Vol. 20, No. 11, November, 1949, pp. 785–794, diagrs., figs. 5 references.

New Balancing Machines for the Dynamic Balancing of Rotors. E. Liselius. *Ericsson Review (Stockholm)*, No. 3, 1948. 15 pp., illus., diagrs., figs. (Reprint No. 566.) (In English.)

A Device for the Measurement of Rotor Temperature in the Air-Driven Ultracentrifuge. Paul Gerard Ecker, Josef Blum, and C. W. Hiatt. *Review of Scientific Instruments*, Vol. 20, No. 11, November, 1949, pp. 799–801, diagrs.

Laws & Regulations (44)

Separating Subsidy from Air Mail Pay. Langdon P. Marvin, Jr. *Air Transportation*, Vol. 15, No. 6 December, 1949, pp. 12, 37, 38.

Lighter-Than-Air (40)

The Future of the Blimp in the Navy. Malcolm W. Cagle. *United States Naval Institute, Proceedings*, Vol. 75, No. 12, December, 1949, pp. 1362–1365, illus.

We're Building Masts for Blimps. *The Martin Star*, November, 1949, p. 2, illus.

Machine Elements (14)

AUTOMATIC CONTROL

How to Obtain Constant Speed Motion Below 10 Rpm. William Hotine. *Product Engineering*, Vol. 20, No. 12, December, 1949, pp. 118–121, diagrs.

Modern Control Dynamics and Stability Criteria as Applied to Gyroscopic Speed Detectors with Hydraulic Drive. Rene Feiss. *American Society of Mechanical Engineers, Transactions*, Vol. 71, No. 8, November, 1949, pp. 979–988, illus., diagrs., figs. 22 references.

BEARINGS

Subzero Lubrication of Bearings. Donald F. Wilcock. *Machine Design*, Vol. 21, No. 11, November, 1949, pp. 92–95, illus., diagrs., figs.

The properties and applications of natural and synthetic oils and greases, and provisions to be made by the designer of machines for adequate lubrication under severe service conditions.

The Calculated Performance of Dynamically Loaded Sleeve Bearings. II. J. T. Burwell. *Journal of Applied Mechanics*, Vol. 16, No. 4, December, 1949, pp. 358–360, figs. 2 references.

Evaluating Load Ratings of Annular Ball Bearings. *Product Engineering*, Vol. 20, No. 12, December, 1949, pp. 87–90, figs.

FASTENINGS

The Distribution of Load in Screw Threads. D. G. Sopwith. *Institution of Mechanical Engineers, Proceedings, Applied Mechanics*, Vol. 159, War Emergency Issue No. 45, 1948, pp. 373–383, figs. 8 references.

Tensile Fillet Stresses in Loaded Projections. R. B. Heywood. *Institution of Mechanical Engineers, Proceedings, Applied Mechanics*, Vol. 159, War Emergency Issue No. 45, 1948, pp. 384–391, Discussion, pp. 391–398, illus., figs. 9 references.

TRANSMISSIONS, CLUTCHES, & DRIVES

Magnetic-Fluid Control Devices. J. Rabinow. *SAE Quarterly Transactions*, Vol. 3, No. 4, October, 1949, pp. 639–648, illus., diagrs., figs.

Maintenance (25)

The Servicing of Aircraft: Choice of Principle and Procedure. Blick Crawley. *Royal Aeronautical Society, Journal*, Vol. 53, No. 468, December, 1949, pp. 1100–1104, figs.

All aircraft parts can be classified as to "predictability" of service life and "inspectability" to determine extent of wear or strain and consequent probability of failure. Periodic inspections should be planned around the predictable parts, and daily and preflight inspections should be planned around the unpredictable parts. The inspection plan, depending broadly upon the type of aircraft and the performance requirements, represents a practical estimate of the maximum feasible amount of preventive work. Having established the optimum servicing principle in that way, the technical procedure is based on the premise that it is less costly to have work done systematically by organized crews at predetermined intervals than for an equal amount of special work to be done piecemeal. Servicing effort and flying time can be saved by accumulating minor items to be repaired as a group at a periodic overhaul time. It is quicker and cheaper to replace a condemned part by a new or reconditioned spare than to repair it on the spot.

Aviation Maintenance's Overhaul Procedure. Howard Mehr. *Aviation Operations*, Vol. 12, No. 5, November, 1949, pp. 41, 42, 78, 79, illus.

American's Airplane Cleaning Arouses Industry Interest. *American Aviation*, Vol. 13, No. 14, December 15, 1949, pp. 39, 40, illus.

Cost Factors in Transport Maintenance. Willis L. Nye. *Aero Digest*, Vol. 59, No. 6, December, 1949, pp. 24, 25, 96, 97, 100, illus.

The Private Market is Here for Accessories. George R. Galipeau. *Aero Digest*, Vol. 59, No. 6, December, 1949, pp. 30, 78, 80, illus.

Winterizing the Small Plane. Ed Packer. *Aviation Operations*, Vol. 12, No. 5, November, 1949, pp. 50, 80, illus.

Boeing Service Guide, No. 26, November, 1949. 12 pp., illus., diagrs. Contents: Removal and Installation of Freon Heat Exchangers. Stratocruiser Cold Weather Procedure. Replacement of Stratocruiser Mirrors. Turbo Amplifier Tube Damage. Wing Flap Lubrication Fitting Clearance. Door Warning Switch Adjustment. Deflate Sticking Oleos When Lowering Jacks. Refrigerant Compressor Motor Grounding Plate. Engine Cooling Prior to Shutdown. Turbo Exhaust Hood—No Step. Engine Mount Bolt Torque. Failure of O-Ring Packing in Female-Threaded Bosses.

Management & Finance (45)

Control of Airline Finances; Close Watch Possible in B.E.A. System. *Modern Transport*, Vol. 62, No. 1600, November 26, 1949, p. 13.

B.O.A.C.'s Reorganization. *The Aeroplane*, Vol. 77, No. 2005, November 11, 1949, p. 637, diagr.

Materials (8)

METALS & ALLOYS

The Economic Value of Increase of Modulus of Elasticity in Aluminum Alloys. H. L. Cox and M. J. Windle. *Aircraft Engineering*, Vol. 21, No. 250, December, 1949, pp. 382, 383. 4 references.

Comparisons are made between normal aluminum alloys and alloys having increased modulus values, for covering the upper surfaces of wings and moderately thick sections, particularly of the smooth-wing type. The weight saving afforded by the new material does not exceed 5 per cent and even that saving results only at edge loadings below present averages, because the advantage of the new material is lost with respect to the sheet and stringers when the working stress exceeds 40,000 lbs. per sq.in., and the loss may offset the weight saving effected in the ribs. Material with higher modulus of elasticity does always afford least weight at a lower value of edge stress, so that a slight weight penalty incurred by the new alloy when the loading is heavy may be justified because the wing stiffness in flexure is increased. At lighter loadings, with lower working stress, the weight saving will exceed 5 per cent and may be as much as 10 per cent.

Aluminum Extrusions; Design Factors and Tolerances. H. V. Menking. *Machine Design*, Vol. 21, No. 11, November, 1949, pp. 127–132, illus., diagrs.

Stability of Alclad Plates. Kenneth P. Buchert. *U.S., N.A.C.A., Technical Note No. 1986*, December, 1949. 33 pp., figs. 7 references.

How Chromium Plate Affects Fatigue Limit. *Aviation Week*, Vol. 51, No. 24, December 12, 1949, pp. 25, 26, figs.

Workhardening of Metals; A General Theory. Alfred M. Freudenthal. *Franklin Institute, Journal*, Vol. 248, No. 6, December, 1949, pp. 523–536, figs. 6 references.

Plastic Behaviour of Solids. Andrew McCance. *Sheet Metal Industries*, Vol. 26, No. 272, December, 1949, pp. 2564–2567. (Extended summary of a paper.)

Kinetic and Structural Factors Involved in Oxidation of Metals. Earl A. Gulbransen. *Industrial and Engineering Chemistry*, Vol. 41, No. 7, July, 1949, pp. 1385–1391, illus., diagrs., figs. 23 references. Protection of metals against high temperatures and corrosion.

The Theory of Eddy Current and Hysteresis Heating of Ferromagnetic Bodies. Mare Jougnet. (*L'Onde Electrique*, Vol. 27, No. 241, April, 1947, p. 138.) *Australia, Council for Scientific and Industrial Research, Division of Aeronautics, Translation No. 11*, August, 1948. 34 pp., figs. 10 references.

Formulas relating to the heating of magnetic conductors under the action of an alternating magnetic field are developed for an infinitely long cylinder and for a sphere. These are applied to the calculation of an actual induction furnace in which the coil and charge are of finite length. The formulas are applicable when

the crucible has the general shape of a sphere, or a cylinder whose height is almost equal to its diameter.

Sintered Products; Developments in Powder-Metallurgy, Porous-Metal De-Icer Panels. *Aircraft Production*, Vol. 11, No. 134, December, 1949, pp. 424, 425, illus.

New Data on Strength of Metals; Basic Structures Design Handbook Revised, Information Expanded on Elevated Temperatures, Fatigue Properties. *Aviation Week*, Vol. 51, No. 21, November 21, 1949, pp. 30–32.

PROTECTIVE COATINGS

Fire-Retardant Coatings for Fabric-Covered Aircraft. S. G. Weissberg and G. M. Kline. *Industrial and Engineering Chemistry*, Vol. 41, No. 8, August, 1949, pp. 1742–1749, illus., diagrs., figs. 3 references.

Simulated power-plant-fire tests of doped fabrics treated with fire-retardant coatings, conducted under still-air, moving-air, and wind-tunnel conditions, demonstrated that the critical time interval between flame contact and fabric destruction can be increased from the present value of two seconds for cellulose nitrate dope or 6 seconds for cellulose acetate butyrate. The protective action of such coatings on cellulose nitrate dope was too small to be of value. Outdoor exposure tests revealed several fire-retardant coating systems with good weathering characteristics, which were deemed worthy of further development. A mixture of boric acid and borax as a fabric impregnant was effective as a fire retardant but had deleterious effects on the adhesion of dope to the fabric.

Meteorology (30)

The Atmosphere and the Future of Aeronautics. *The Aeroplane*, Vol. 77, No. 2007, November 25, 1949, pp. 698–700, illus., figs. (Extended summary of a paper: "The Earth's Atmosphere" by Howard E. Roberts.)

The Atmosphere and its Characteristics. Howard E. Roberts. *The Aeroplane*, Vol. 77, No. 2006, November 18, 1949, pp. 672, 673, diagr. (Extended summary of a paper: "The Earth's Atmosphere.")

Measurement of Visibility by Photographic Photometry. Carsten Steffens. *Industrial and Enginering Chemistry*, Vol. 41, No. 11, November, 1949, pp. 2396–2399, illus., diagrs. 19 references.

The method consists of photographing a section of the landscape and measuring on the negative the relative optical densities of the images of suitable objects. From those data, together with the photometric characteristics of the negative and the distance of the objects, the visual range can be calculated.

The Weather Bureau-Air Force-Navy Analysis Center. Joseph Vederman. *American Meteorological Society, Bulletin*, Vol. 30, No. 10, December, 1949, pp. 335–341, illus., diagrs. 2 references.

Some Remarks Concerning the Gradient-Wind Equation. Warren L. Godson. *American Meteorological Society, Bulletin*, Vol. 30, No. 10, December, 1949, pp. 342–346, figs. 9 references.

Humidity of the Lower Stratosphere; The Results of High-Level Ascents by Aircraft of the Meteorological Research Flight. H. C. Shellard. *The Meteorological Magazine*, Vol. 78, No. 930, December, 1949, pp. 341–349, figs. 2 references.

A Note on the 1000-700-mb. Thickness and the Height of the Freezing Level Over the British Isles. R. Murray. *The Meteorological Magazine*, Vol. 78, No. 930, December, 1949, pp. 349–351.

The Effect of Water Droplets on the Buoyancy of a Rising Cumulus Cloud. J. M. Craddock. *The Meteorological Magazine*, Vol. 78, No. 930, December, 1949, pp. 351–354, fig. 5 references.

Observations of a Thunderstorm From Small Cumulonimbus. F. H. Ludlam. *The Meteorological Magazine*, Vol. 78, No. 930, December, 1949, pp. 357–360, figs.

Luminous Night Clouds. J. Paton. *The Meteorological Magazine*, Vol. 78, No. 930, December, 1949, pp. 354–357, illus. 10 references.

Artificial Production of Precipitation. Third Partial Report—Orographic Stratiform Clouds, California, 1949. Fourth Partial Report—Cumuliform Clouds, Gulf States, 1949. Richard D. Coons, Earl L. Jones, and Ross Gunn. *U.S. Weather Bureau*,

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Research Paper No. 33, September, 1949. 46 pp., illus., figs. 4 references.

Military Aviation (24)

A Matter of Nomenclature. J. M. Spaight. *Air University Quarterly Review*, Vol. 3, No. 2, Fall, 1949, pp. 24–29. Discussion of the former and present meanings and applications of the terms "strategic" and "tactical," with particular reference to air operations.

Ideas are Weapons. David A. Burchinal. *Air University Quarterly Review*, Vol. 3, No. 2, Fall, 1949, pp. 3–12. Application of the lessons of World War II to the plans for the defense of the nation in the event of another conflict.

Integration for Air Power. Gill Robb Wilson. *Sperryscope*, Vol. 11, No. 11, Autumn, 1949, pp. 9–11, illus.

Refuelling Operation "Vittles." *Air World*, Vol. 2, No. 3, November, 1949, pp. 77–80, illus.

Air Route Command; MATS and its Objectives. Laurence S. Kuter. *The Pegasus*, Vol. 14, No. 6, December, 1949, pp. 1–4. illus.

Navy's Aviation Supply Office. Richard E. Stockwell. *Aviation Operations*, Vol. 12, No. 6, December, 1949, pp. 32, 33, 59, 60, 62, 63, illus.

Flak Defenses of Strategic Targets in Southern Germany. Norman E. Hartman. *Antiaircraft Journal*, Vol. 92, No. 6, November–December, 1949, pp. 33–37, figs.

Trial Fire Spotting with Radar. James N. Olhausen and Francis P. LeMere. *Antiaircraft Journal*, Vol. 92, No. 6, November–December, 1949, pp. 2–6, diagrs., figs.

The Future Officer of the U.S.A.F.; A Problem of Training in New Purposes, New Traditions. Hoyt S. Vandenberg. *Sperryscope*, Vol. 11, No. 11, Autumn, 1949, pp. 2–5, illus.

La Logistica y Las Regiones Areas (Air Logistics). Manuel Martinez Merino. *Revista de Aeronautica*, Vol. 8, No. 95, October, 1948, pp. 753–758, illus.

La Aviacion en la Segunda Guerra Mundial; Campanas de Los Balcanes Y del Africa Oriental (Aviation in the Second World War: Campaigns in the Balkans and East Africa). Fernando Querol. *Revista de Aeronautica*, Vol. 8, No. 92, July, 1948, pp. 505–510, illus., figs.

Las Fuerzas Aereas en la Segunda Guerra Mundial; La Lucha en Rusia Hasta Stalingrado (The Air Forces in the Second World War; The Battle in Russia up to Stalingrad). Fernando Querol. *Revista de Aeronautica*, Vol. 8, No. 94, September, 1948, pp. 683–687, illus.

Las Fuerzas Aereas en la Segunda Guerra Mundial; De Stalingrade a Berlin (The Air Forces of the Second World War; From Stalingrad to Berlin). Fernando Querol. *Revista de Aeronautica*, Vol. 8, No. 95, October, 1948, pp. 759–763, illus.

Las Fuerzas Aereas en la Segunda Guerra Mundial; Preparacion del Segundo Frente (The Air Forces of the Second World War; Perparation for the Second Front). Fernando Querol. *Revista de Aeronautica*, Vol. 8, No. 96, November, 1948, pp. 833–838, illus.

Las Fuerzas Aereas en la Segunda Guerra Mundial; El Segundo Frente (The Air Forces of the Second World War; The Second Front). Fernando Querol. *Revista de Aeronautica*, Vol. 8, No. 97, December, 1948, pp. 931–937, illus.

Navigation (29)

Recent Developments in Polar Navigation. Alton B. Moody. *Navigation*, Vol. 2, No. 3, September, 1949, pp. 62–67, illus., fig.

More accurate directional gyro instruments and the Pfund sky compass have helped greatly in the determination of direction, especially during the polar twilight period, and a twilight computer that is set according to the sun's declination and Greenwich Hour Angle facilitates the determination of position. Directional computation has been made easier by a Local Hour Angle computer for use with the astro compass. Substitution of a simple graph for the directional gyro log reduces the calculation work by 75 per cent. Celestial navigation has been improved by simplified computation, the use of exact almanac tabulated time, and a second-setting watch. Drift and ground speed are measured by a gyro-stabilized drift meter or by radar tracking. Numerous improvements also have been made in charts.

The Instrumental Ideal. A. J. Bastein. *Institute of Navigation, Journal*, Vol. 2, No. 4, October, 1949, pp. 304–314, figs.

The fundamentals of a mechanical system of astro-navigation that would give immediate and continuous readings of latitude and longitude. The apparatus could consist of photo-electric cells, an optical system, and a motor-driven follow-up mechanism to keep within view the heavenly body upon which the optical system is trained. Dials actuated by a clockwork movement running on sidereal time could indicate longitude, and angles measured by a graduated half-circle and a mercury drop or light-weight ball could indicate latitude.

The Use of Astro-Navigation in Fast Aircraft. A. H. Jessell. *Institute of Navigation, Journal*, Vol. 2, No. 4, October, 1949, pp. 282–285.

The Inadequacy of Present-Day Methods (of Astronomical Navigation). Francis Chichester. *Institute of Navigation, Journal*, Vol. 2, No. 4, October, 1949, pp. 295, 296.

The Requirements for Astronomical Navigation. J. B. Parker. *Institute of Navigation, Journal*, Vol. 2, No. 4, October, 1949, pp. 276–281.

Navigation by the Rule of Sixty. E. S. Quilter. *Navigation*, Vol. 2, No. 3, September, 1949, pp. 55–57.

A New Method of Observation and Reduction. Robert Genty. *Institute of Navigation, Journal*, Vol. 2, No. 4, October, 1949, pp. 293–295, diagrs.

Methods of Plotting and Reduction. P. F. Everitt. *Institute of Navigation, Journal*, Vol. 2, No. 4, October, 1949, pp. 290–292, illus.

The Possibility of an Altitude-Azimuth Almanac for Air Navigation. D. H. Sadler. *Institute of Navigation, Journal*, Vol. 2, No. 4, October, 1949, pp. 285–289. 3 references.

Air Navigation by Zenith-Photography. R. d'E. Atkinson and E. Brett Hilder. *Institute of Navigation, Journal*, Vol. 2, No. 4, October, 1949, pp. 297–304, diagr., fig.

Standards on Radio Aids to Navigation; Definitions of Terms, 1949. *Institute of Radio Engineers, Proceedings*, Vol. 37, No. 12, December, 1949, pp. 1364–1371.

Parachutes

Notes on the Opening Behaviour and the Opening Forces of Parachutes. F. O'Hara. *Royal Aeronautical Society, Journal*, Vol. 53, No. 467, November, 1949, pp. 1053–1062, figs. 8 references.

The rate of canopy development is computed from the excess of the mean velocity of inflow through the mouth over the mean velocity of the outflow through the end and the porosity of the fabric, and the formula is used for analysis of the parachute opening forces. The critical opening speed varies with the porosity of the fabric and the number and length of the rigging lines. If the critical opening speed is exceeded the parachute opens only to the "squid" state and does not open fully until the speed is reduced. Excess fabric forms indentations around the canopy mouth at speeds above the critical value, affecting the rapid opening of the canopy, and that may also explain the collapse of the inflated canopy. The equation for computing the rate of canopy opening shows that, in general, the factors reducing the inflow at the mouth in proportion to the outflow at the end lead to slowing the rate of development. The formula is not exact and requires estimation of the porosity factor, but results compare reasonably well with rates deduced from motion-picture records of parachute drops. Analysis of parachute development forces is based on the mass of the dropped body, radius of parachute, air speed of the system, and parachute air-drag coefficient, and the theory is used to compare the parachute forces acting on the dropped body at different altitudes. The maximum force increases with altitude, due to a combination of causes, but is principally due to the larger contribution from the rate of change of momentum of the growing initial air mass. The theory does not include the constraining effect of the rigging lines, which could be calculated by an equation of work, but the extra complication is scarcely justified and the assumption of a mean value shows the constraint to be equivalent to reducing the mass of the dropped body.

Personal Flying (42)

Progressive Private Aviation Promotion. *Western Flying*, Vol. 29, No. 12, December, 1949, pp. 8, 9, illus.

Power Plants

Combustion; Second Annual Unit Process Review. Bernard Lewis and Guenther von Elbe. *Industrial and Engineering Chemistry*, Vol. 41, No. 9, September, 1949, pp. 1851–1862. 293 references.

Report of progress made in research on gaseous and carbon combustion, explosives, propellants, furnaces, and burners, which is based on papers published during late 1947 and all of 1948. It includes a review of the work done on piston engines, gas turbines, and jet and rocket propulsion.

Compound Powerplants. P. H. Schweitzer and J. K. Salisbury. *SAE Quarterly Transactions*, Vol. 3, No. 4, October, 1949, pp. 656–670, illus., diagrs., figs. 15 references.

Wright Turbo-Cyclone 18. W. G. Lundquist. *Shell Aviation News*, No. 136, October, 1949, pp. 21, 22, fig.

Posible Evolucion de Los Sistemas de Propulsion en el Futuro Proximo (Possible Evolution of Propulsion Systems in the Near Future). *Ingenieria Aeronautica*, Vol. 1, No. 1, January–March, 1949, pp. 19–37, illus., figs.

JET & TURBINE (5)

The Measurement of Gas Turbine Combustion Efficiency by Gas Analysis. L. J. Richards and J. C. Street. *The Aeronautical Quarterly* (Royal Aeronautical Society, London), Vol. 1, Part II, August, 1949, pp. 165–186, diagrs. 5 references.

A brief summary of techniques developed at the Thornton Research Center for the rapid analysis of combustion gas, the sampling and interpretation of results, and the determination of gas-turbine efficiency when the exhaust products are wholly gaseous at the sampling temperature and when the combustion chamber exhaust products contain liquid fuel. The accuracy and the time required for the determination of CO, CO_2, and H_2 are tabulated for the original Cambridge vacuum and the modified Cambridge vacuum methods, the infrared gas analyser, the combustimeter, and the pH method.

Burners for Supersonic Ram-Jets; General Aspects of the Problem. James W. Mullen, II. *Industrial and Engineering Chemistry*, Vol. 41, No. 9, September, 1949, pp. 1935–1945, illus., figs. 71 references.

Examination of the internal-flow conditions in a supersonic ram jet emphasizes the high linear velocities in the region where heat must be added to the air stream. At present the critical burner problem is flame stabilization at those high velocities, so that combustion can be sustained. By providing suitable baffles, such as spheres, cylinders, or sharp-edged discs, the air stream is directed so as to provide zones of relative quiet in which stable combustion can occur. Three essential requirements for a satisfactory ram-jet burner are high efficiency, low internal drag, and a wide range of stable operation. The fundamental fuel property most closely related to potential thrust is the heat of combustion per unit weight of air, and economy is determined by combustion heat per unit weight of fuel. Liquid hydrogen, methanol, and pentane are among the suitable fuels, each offering various advantages for specific applications.

Design of Propeller-Turbine Combinations. A. B. Haines. *Gt. Brit., Aeronautical Research Council, Reports and Memoranda No. 2306*, November, 1945. 32 pp., figs. 10 references. British Information Services, New York. $1.40.

The Westinghouse J34 Endurance Test. Nathaniel F. Silsbee. *Aviation Operations*, Vol. 12, No. 6, December, 1949, pp. 42, 43, 69, 70, illus., diagr.

Tale of a Turbojet. Robert L. Wells. *Aero Digest*, Vol. 59, No. 6, December, 1949, pp. 40, 41, 101, 102, illus. Western Electric Corp., 24c (J34).

Sand and Dust Erosion in Aircraft Gas Turbines. J. E. DeRemer. *Aero Digest*, Vol. 59, No. 6, December, 1949, pp. 46, 47, 74, illus., diagr., figs. (Extended summary of a paper.)

Ryan Tailpipes for the Stratojets. *Ryan Reporter*, Vol. 10, No. 9, December 6, 1949, pp. 4, 5, illus.

Tailpipe Reheat; A Specialized Research Programme Reviewed, Potentialities Assessed. John L. Edwards. *Flight*, Vol. 56, No. 2139, December 22, 1949, pp. 805–807, illus., diagrs., figs.

Production Problems of Turbojet Engines. T. S. McCrae. *SAE Quarterly Transactions*, Vol. 3, No. 4, October, 1949, pp. 582–591, illus., figs. 1 reference.

Checking Castings. *Aircraft Production*, Vol. 11, No. 134, December, 1949, pp. 413–420, illus., figs.

Economies are achieved by the use of "sighting fixtures" that permit the checking of castings for dimensional accuracy without the usual "marking out" process.

Strain Measurements on Rotating Parts. R. E. Gorton and R. W. Pratt. *SAE Quarterly Transactions*, Vol. 3, No. 4, October, 1949, pp. 540–556, illus., figs. 20 references.

Allison's XT-40 Turbo-Prop Better Than Britain's Best. *American Aviation*, Vol. 13, No. 14, December 15, 1949, p. 14, illus.

Proteus and Coupled-Proteus Turbines. *The Aeroplane*, Vol. 77, No. 2009, December 9, 1949, pp. 783–787, illus., figs., cutaway drawing.

RECIPROCATING (6)

Analysis of Variation of Piston Temperature with Piston Dimensions and Undercrown Cooling. J. C. Sanders and W. B. Schramm. *U.S., N.A.C.A., Report No. 895*, 1948. 10 pp., illus., figs. 11 references. U.S. Govt. Printing Office, Washington. $0.15.

Geared Engine for Lightplanes. *Aviation Week*, Vol. 51, No. 25, December 19, 1949, p. 16, illus.

The Maintenance of Aero-Engine Pipes; Notes on the Cleaning, Inspection and Repair of Metal and Flexible Pipes. J. W. Tomlinson. *Aircraft Engineering*, Vol. 21, No. 250, December, 1949, pp. 383, 387, illus., diagrs.

ROCKET (4)

Maintenance of Near Equilibrium During Isentropic Expansions Through a Nozzle. S. S. Penner. *American Chemical Society, Journal*, Vol. 71, No. 3, March, 1949, pp. 788–791. 8 references.

A criterion derived for near-equilibrium flow during isentropic expansion through a rocket nozzle shows the result attained by K. Schaefer to be valid for recombinations in a system in which temperature and pressure changes produce concentration changes that are superimposed on those concentration changes that are caused by chemical reaction under conditions existing in the rocket engines in current use.

Mass Ratios. A. V. Cleaver. *British Interplanetary Society, Journal*, Vol. 8, No. 5, September, 1949, pp. 173–179, diagr. 4 references.

Definitions and formulas for the calculation of the various kinds of mass ratio used in the evaluation of the performance of multi-step rockets. True mass ratio is the ratio of total mass at take-off to the final mass at destination. Individual step-mass ratio is the measurement of the separate steps just as though each were a single rocket, but the various values are not necessarily equal. Effective step-mass ratio measures the contribution of each step to the overall effective mass ratio, and the latter term is the sum of the velocities so contributed to the whole assembly. Alternative parameters such as structural factor, pay-load ratio, and propellant mass ratio are suggested to avoid the confusion of reference to several different sorts of "mass ratio."

A Critical Analysis of Solid Chemical Rocket Propulsion. Alfred J. Zaehringer. *Rocketscience*, Vol. 3, No. 4, December, 1949, pp. 81–87, diagrs. 3 references.

In addition to the usual attributes of high heat content, high density of propellant and low molecular weight of effluent gases, and high adiabatic flame temperature, solid propellants must have high combustion velocity, low temperature sensitivity, and should perform at low chamber pressures. Carbon monopropellants with the desired properties can be made easily. Improved cooling methods, better control, and greater ease of operation will help to place the solid-propellant rocket on an equal footing with the liquid-fuel rocket.

The Penemunde Rocket Projects. Hans K. Kaiser. *Rocketscience*, Vol. 3, No. 4, December, 1949, pp. 92, 93.

de Havilland "Sprite" Liquid Fuel Rocket. *Shell Aviation News*, No. 136, October, 1949, pp. 18–20, diagrs., figs.

Production (36)

Peak Output. II. *Aircraft Production*, Vol. 11, No. 134, December, 1949, pp. 408–411, figs. 7 references.

Analyses of British, American, German, and Japanese aircraft production figures during the peak production years of the recent war are made by means of a logistic curve for judging past achievements through the production-growth index. Standard

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curves for various values of the growth index are developed for use in planning production schedules and in estimating the output capacity of a plant.

Statistical Analysis of Experimental Data. E. Rossow. *Aircraft Engineering*, Vol. 21, No. 250, December, 1949, pp. 378–381, figs. 7 references.

A graphical method using probability-paper plotting saves time where automatic calculating machines are not available. Its importance lies in the possibility of separating samples into groups according to independent Gaussian "populations" that were mixed up in production prior to the sampling. Its use is indicated for judging bimodal or multimodal frequency distributions.

Radical Production. *The Aeroplane*, Vol. 77, No. 2010, December 16, 1949, pp. 813–815, illus.

Assembling aircraft components from the skin inward insures accuracy of the final aerodynamic envelope, of frame and rib spacing, and of cleavage lines. The method permits assembly of any component as soon as parts become available, without waiting for a complete set of parts.

Target Rigging; Deflection and Alignment Checks on the Brabazon Airframe. Arthur W. Morgan. *Aircraft Production*, Vol. 11, No. 134, December, 1949, pp. 396–398, illus., diagrs.

A new method based on the use of the aircraft datum lines, lithographed "target plates," and theodolites, for measuring the deflections of the structure caused by moving it from the construction hangar to the assembly hall, and for realigning and restoring the structure to its original position.

Envelope Jigs for Aircraft Construction. I. II. *The Engineer*, Vol. 188, Nos. 4897, 4898, December 2, 9, 1949, pp. 651, 652; 672, 673, illus.

Production Processes, Their Influence on Design. XLVIII—Die Casting. Roger W. Bolz. *Machine Design*, Vol. 21, No. 11, November, 1949, pp. 115–124, illus., diagrs.

The Engineering Manual; Its Function and Maintenance. J. T. Bennett. *Machine Design*, Vol. 21, No. 11, November, 1949, pp. 99–105, diagrs.

The Drafting Room Manual of North American Aviation, Inc. supplements standard engineering handbooks by providing, in readily usable form, specialized information applying to the company's particular projects. There are sections for materials, dimensions and tolerances, standard parts, machining, fabrication, structures, finishes, and adhesives. Methods of preparing copy, editing, printing, and distribution are described.

Static Failure and Fatigue of Steels with Particular Reference to Welded Structures. II. M. Roš. *Sheet Metal Industries*, Vol. 26, No. 272, December, 1949, pp. 2625–2654, 2656, 2658, illus., diagrs., figs. 7 references.

Pressure Welding Being Studied. *Aviation Week*, Vol. 51, No. 24, December 12, 1949, pp. 36, 38, illus.

Superfinishing. II—Operating Conditions, Flat-Surface Superfinishing. E. J. Napier. *Aircraft Production*, Vol. 11, No. 134, December, 1949, pp. 421–423, illus., fig.

Machining Nimonic; Notes Based Upon Current Practice in the Processing of the Wiggin Series of High-Nickel Alloys. *Aircraft Production*, Vol. 11, No. 134, December, 1949, pp. 399–404, illus., diagrs.

Simple Tooling; Small-Scale Production of a Difficult Fuselage-Member. L. G. Burnard. *Aircraft Production*, Vol. 11, No. 134, December, 1949, pp. 393–395, illus., figs.

Details of the simplified equipment and operations used in fabricating a composite longeron member by drawing and stretching the sheet material over a form block, routing it to the desired contour, and drilling for bolts and rivets.

Sprayed "Envelopes" Protect Aircraft Skins. *Aero Digest*, Vol. 59, No. 6, December, 1949, pp. 38, 39, illus. Protective plastic coating sprayed upon surfaces of sheet metal before fabrication and peeled off after assembly.

Industrial Vulnerability in the Atomic Age. George R. Charlton. *Air University Quarterly Review*, Vol. 3, No. 2, Fall, 1949, pp. 13–23.

Propellers (11)

Aerodynamic Balancing of Propellers. H. L. Milner. *Royal Aeronautical Society, Journal*, Vol. 53, No. 468, December, 1949, pp. 1071–1084, illus., diagrs., figs.

Analysis showed that aerodynamic unbalance of propellers is a principal factor in aircraft vibration. The resultant air load acting on an elementary length of the blade can be resolved into two components that are defined as thrust balance and torque balance. To facilitate blade testing without rotating the blade under power, the Rotol aerodynamic balancing machine was devised for measuring those forces. Its essential components are a table to support the blade in calibrating position and a target frame parallel to it. The table has six blade-caliper gages, in each of which the clinometer is replaced by an optical projector with its optic axis perpendicular to the gage axis. Each projector throws an image of an illuminated cross onto a corresponding adjustable plaque carried by the target frame. The gages can move in vertical planes defined by the radii of the gaging stations on the blade. Those vertical distances are set according to the dimensions of an ideal blade. In operation, the light images are made to coincide with their targets and any adjustments are transmitted to a pointer that indicates the angular correction to be applied to the blade to obtain aerodynamic balance. The machine can be used for balancing individual blades and in assembling sets of blades into propeller units.

Experimental Investigation of Flutter of a Propeller with Clark Y Section Operating at Zero Forward Velocity at Positive and Negative Blade-Angle Settings. John E. Baker and Russell S. Paulnock. *U.S., N.A.C.A., Technical Note No. 1968*, December, 1949. 13 pp., diagr., figs. 2 references.

Bending Vibration of a Rotating Blade Vibrating in the Plane of Rotation. R. L. Sutherland. *Journal of Applied Mechanics*, Vol. 16, No. 4, December, 1949, pp. 389–394, figs. 5 references.

A Matrix Method of Calculating Propeller-Blade Moments and Deflections. R. Plunkett. *Journal of Applied Mechanics*, Vol. 16, No. 4, December, 1949, pp. 361–369, figs. 7 references.

Reference Literature (47)

HISTORY

England-Australia Anniversary; An Epic of Thirty Years Ago, Britain and Australia First Linked by Air. *Flight*, Vol. 56, No. 2137, December 8, 1949, pp. 724, 725, illus.

Glenn L. Martin's First 40 Years. Devon Francis. *Flying*, Vol. 46, No. 1, January, 1950, pp. 21–26, 51–56, illus.

The National Air Museum. Paul Edward Garber. *Sperryscope*, Vol. 11, No. 11, Autumn, 1949, pp. 18–20, illus.

Research Facilities (50)

NAA Builds Huge Propulsion Lab. *Aviation Week*, Vol. 51, No. 25, December 19, 1949, pp. 28, 29, illus.

Rotating Wing Aircraft (34)

A Theory of Airflow Through Rotors and its Application to Some Helicopter Problems. J. Meijer Drees. *Helicopter Association of Great Britain, Journal*, Vol. 3, No. 2, July-August-September, 1949, pp. 79–104, figs. 9 references.

With the aid of simplifying assumptions, an investigation of the axial flow through a rotor is carried out by calculating the velocity components perpendicular to the tip-path plane caused by a system of free and bound vortexes. The problem is divided into calculations of the induced velocities of the bound vortexes, of the free tip vortexes with a constant circulation, and of the free radial vortexes and tip vortexes with a circulation depending upon the azimuth angle. A chart for the simple evaluation of the average axial velocity is valid for all single-rotor helicopters and autogiros and for all possible straight-flight conditions. A formula for the axial flow at 75 per cent of the rotor radius as a function of the azimuth angle shows that in forward flight the axial flow increases from the front side to the rear side of the rotor, and that an unexpected difference exists in axial flow in the lateral direction. By applying the theory to several problems, in some cases involving the Sikorsky S-51 helicopter, the location of the region of roughness in a diagram of forward and vertical velocity is found. The theory predicts quite accurately the cyclic pitch angle relative to the forward speed, except at very low speeds.

Helicopter Transmission Systems. Kenneth Watson. *Helicopter Association of Great Britain, Journal*, Vol. 3, No. 2, July-August-September, 1949, pp. 44–77, illus., diagrs.

Five components are essential for a helicopter power transmission system. These are an engaging clutch to enable engine

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starting independent of the rotor; a free-wheeling or over-riding device for use in case of engine failure; a drive shaft with supports and flexible couplings to transmit power at an angle; damping mechanisms to absorb peak loads; and speed-change gearing. All of these are exemplified in a detailed description of the transmission of the Cierva "Air Horse" helicopter. Alternative gearbox layouts provide means for driving a three-rotor helicopter having twin-engine power plants using air-cooled or liquid-cooled piston engines or gas turbines. A proposed two-speed-change-gear unit could be used in a typical single-rotor layout.

Single Bearing Hub Design for Jet Powered Rotors. Paul Baumgartl. *American Helicopter*, Vol. 16, No. 11, October, 1949, pp. 8, 17, illus.

New York Port Authority Backs Helicopter Service. G. F. Champlin. *American Helicopter*, Vol. 16, No. 11, October, 1949, pp. 15–17.

British Helicopter Spraying. *Air World*, Vol. 2, No. 3, November, 1949, pp. 68, 69, illus.

Helicopter Transport Outlook Good; AF Order Coming. James J. Haggerty, Jr. *American Aviation*, Vol. 13, No. 14, December 15, 1949, pp. 11–13, illus., diagrs.

In the Helicopter After Dark. Alexander Klemin. *Aero Digest*, Vol. 59, No. 6, December, 1949, pp. 52, 53, 104, 106, illus., diagr., figs. Summary of reports on night-flying experiments and the conclusions reached.

12 Passenger Bell Feederliner. Charles Williams. *American Helicopter*, Vol. 16, No. 11, October, 1949, p. 13, illus.

Helicopter Contrasts. *The Aeroplane*, Vol. 77, No. 2005, November 11, 1949, p. 643, illus. The American Hiller 360 and the French S. O. Ariel.

United Helicopters' (Hiller 360) Air Ambulance. M. Berry. *American Helicopter*, Vol. 16, No. 11, October, 1949, p. 14, illus.

HRP-1 (Piasecki) "Rescuers" Live Up to Their Name. Frank Coleman. *American Helicopter*, Vol. 16, No. 11, October, 1949, pp. 10, 11, 18, illus.

Helicopter Close-Ups. *The Aeroplane*, Vol. 77, No. 2004, November 4, 1949, p. 621, illus. Photographs of the American Sikorski S-52 and the rotor-head of the Cierva Skeeter 2.

Sikorsky's Double-Deck Helicopter (H-19). *Aviation Week*, Vol. 51, No. 24, December 12, 1949, p. 15, illus.

Royal Air Force Beaulieu Display. C. Colin Cooper. *American Helicopter*, Vol. 16, No. 11, October, 1949, pp. 6, 7, illus.

Sciences, General (33)

MATHEMATICS

Investigation of Biharmonic Boundary Value Problems and Two Dimensional Elasticity Equations. N. Muschelisvili. (*Matematische Annalen*, Vol. 107, No. 2, 1932, pp. 282–312.) *Australia, Council for Scientific and Industrial Research, Division of Aeronautics, Translation No. 9*, February, 1946. 55 pp. 15 references.

Cauchy's integral method, which leads to simple Fredholm equations, is used for the complete solution of the fundamental biharmonic problem of a finite domain bounded by a simple closed curve (the "interior problem") and for an infinite domain (the "exterior problem"). Two fundamental problems in two-dimensional elasticity also are solved by similar methods, for finite and infinite domains bounded by a single closed contour.

The Mathematical Development of the End-Point Method. S. Frankel and S. Goldberg. *U.S., Atomic Energy Commission, Document No. 2056*, April 10, 1945 (Declassified June 17, 1948). 45 pp., figs. Document Sales Agency, Atomic Energy Commission, P.O. Box 62, Oak Ridge, Tenn. $0.20.

Properties of the Confluent Hypergeometric Function. A. D. MacDonald. *Journal of Mathematics and Physics*, Vol. 28, No. 3, October, 1949, pp. 183–191, tables. 10 references.

Evaluation of an Integral of a Bessel Function. Wilton R. Abbott. *Journal of Mathematics and Physics*, Vol. 28, No. 3, October, 1949, pp. 192–194. 4 references.

MECHANICS—VIBRATION

On Vibrations of a Two-Bar Elastic System with a Small Rise. S. Woinowsky-Krieger. *Journal of Applied Mechanics*, Vol. 16, No. 4, December, 1949, pp. 395–398, figs. 3 references.

Vibration of Multifrequency Systems During Acceleration Through Critical Speeds. G. D. McCann, Jr. and R. R. Bennett.

Journal of Applied Mechanics, Vol. 16, No. 4, December, 1949, pp. 375–382, illus., figs. 4 references.

Response of an Elastically Non-Linear System to Transient Disturbances. Rune L. Evaldson, Robert S. Ayre, and Lydik S. Jacobsen. *Franklin Institute, Journal*, Vol. 248, No. 6, December, 1949, pp. 473–494, diagrs., figs.

Energy Method of Calculating Vibration Modes and Frequencies. Walter W. Soroka. *Product Engineering*, Vol. 20, No. 12, December, 1949, pp. 91–93, diagrs., figs.

Structures (7)

Displacements of a Linear Elastic System Under a Given Transient Load. I. D. Williams. *The Aeronautical Quarterly* (Royal Aeronautical Society, London), Vol. 1, Part II, August, 1949, pp. 123–136, figs.

Since in an elastic system under a given transient load, the inertia forces in the series of normal modes, in many practical cases, converge rapidly compared with the series of "normal" loadings in terms of which the spatial distribution of the applied load can be expressed, the complete behavior of the system can be accurately and rapidly obtained by adding the displacement produced by the actual applied load to the static displacements produced by the inertial loadings for only those modes of the system in which the inertia forces are not negligible.

The Design of Compression Structures for Minimum Weight. D. J. Farrar. *Royal Aeronautical Society, Journal*, Vol. 53, No. 467, November, 1949, pp. 1041–1052, figs. 7 references.

The Z-section stringer-skin combination is chosen as an example because of its extensive use. It is subject to skin buckling, to instabilities of local, torsional, and flexural nature, to inter-rivet buckling, and to wrinkling. Two cases are considered, in the first primary or initial local buckling causes flexural failure and in the second, skin buckling develops and flexural failure is precipitated by secondary local buckling. It is assumed that inter-rivet buckling and wrinkling are avoided by suitable spacing of rivets. The most efficient structure is that one in which all types of instability that could cause failure would occur simultaneously. Of the other two usual stringer-skin combinations, the Y-section and the hat section, the more efficient is the Y-section, for practical purposes. Where the loading-coefficient value, that is, the ratio of compressive end load to the rib or frame spacing, is less than 100, the Z-section is satisfactory and is generally more robust. Present aluminum alloys are most efficient at high loading-coefficient values and magnesium alloys are best for lower values. Another promising development is an aluminum alloy with its Young's modulus increased by 30 per cent. Analysis of the relationship between the weight and the spacing of the ribs shows that the weight of ribs should be about half that of the skin and stringers combined. Design charts, based on the loading coefficient, enable a good and rapid approximation to the final optimum structure, with allowance for other practical design factors.

Problems of Aircraft Life Evaluation. Joel M. Jacobson. *SAE Quarterly Transactions*, Vol. 3, No. 4, October, 1949, pp. 616–633, illus., figs. 12 references.

Wing Divergence: Danger in Fast Flight; Flexibility of Airfoil Structure Creates Grave Stability, Control and Structural Problems for Plane Designer. Robert McLarren. *Aviation Week*, Vol. 51, No. 25, December 19, 1949, pp. 21, 22, 25–27, figs. 21 references.

Some Effects of Density and Mach Number on the Flutter Speed of Two Uniform Wings. George E. Castile and Robert W. Herr. *U.S., N.A.C.A., Technical Note No. 1989*, December, 1949. 20 pp., figs. 2 references.

Practical Solution of the Fundamental Boundary Value Problems of Elasticity in a Plane for Various Contours. N. Muschelisvili. (*Zeitschrift für Angewandte Mathematik und Mechanik*, Vol. 13, No. 4, August, 1933.) *Council for Scientific and Industrial Research, Division of Aeronautics, Translation No. 7*, January, 1945. 44 pp., figs. 16 references.

On Torsion of Plastic Bars. P. G. Hodge, Jr. *Journal of Applied Mechanics*, Vol. 16, No. 4, December, 1949, pp. 399–405, figs. 7 references.

Discontinuities of Stress in Plane Plastic Flow. Alice Winzer and G. F. Carrier. *Journal of Applied Mechanics*, Vol. 16, No. 4, December, 1949, pp. 346–348, figs. 4 references.

Plastic Buckling of a Long Flat Plate Under Combined Shear and Longitudinal Compression. Elbridge Z. Stowell. *U.S., N.A.C.A., Technical Note No. 1990*, December, 1949. 17 pp., figs. 6 references.

New Interpretation of the *n*-Power Law in Plastic Deformation. Herbert I. Fusfeld. *Journal of Applied Physics*, Vol. 20, No. 11, November, 1949, pp. 1052–1055, figs. 1 reference.

Relation of Experiments to Mathematical Theories of Plasticity. D. C. Drucker. *Journal of Applied Mechanics*, Vol. 16, No. 4, December, 1949, pp. 349–357, figs. 17 references.

Impact of a Mass on a Column. W. H. Hoppmann. *Journal of Applied Mechanics*, Vol. 16, No. 4, December, 1949, pp. 370–374, figs. 5 references.

Determination of the Buckling Load for Columns of Variable Stiffness. C. C. Miesse. *Journal of Applied Mechanics*, Vol. 16, No. 4, December, 1949, pp. 406–410, figs. 4 references.

On Internal Damping of Rotating Beams. Morris Morduchow. *U.S., N.A.C.A., Technical Note No. 1996*, December, 1949. 14 pp., figs. 9 references.

Tables Aid Solution of Beam Deflection Problems. J. D. Swannack. *Machine Design*, Vol. 21, No. 11, November, 1949, pp. 149–151, figs.

A Force Applied in the Median Plane at the Center of a Circular Insert in a Plate. S. J. Dokos. *Journal of Applied Mechanics*, Vol. 16, No. 4, December, 1949, pp. 411–413, figs. 3 references.

Stresses in Laterally Loaded Disks of Nonuniform Thickness. T. H. Gawain and E. C. Curry. *Product Engineering*, Vol. 20, No. 12, December, 1949, pp. 130–134, figs.

A Simplified Method of Elastic-Stability Analysis for Thin Cylindrical Shells. S. B. Batdorf. *U.S., N.A.C.A., Report No. 874*, 1947. 25 pp., illus., diagrs., figs. 26 references. U.S. Govt. Printing Office, Washington. $0.20.

Readers' Forum: Stability of Sandwich Plates in Combined Shear and Compression. P. P. Bijlaard. *Journal of the Aeronautical Sciences*, Vol. 17, No. 1, January, 1950, p. 63. 5 references.

Biaxial Tension-Tension Fatigue Strengths of Metals. Joseph Marin. *Journal of Applied Mechanics*, Vol. 16, No. 4, December, 1949, pp. 383–388, illus., diagrs., figs. 12 references.

The Determination of Vibration Modes. N. F. Harpur. *Royal Aeronautical Society, Journal*, Vol. 53, No. 468, December, 1949, pp. 1095–1099, illus., figs.

A 1000-Ton Horizontal Structure-Testing Machine. II. *The Engineer*, Vol. 188, No. 4896, November 25, 1949, pp. 620–622, illus.

Sobre el Cálculo de Estructuras Monocasco Modernas de Aviones (On the Calculation of Modern Monocoque Structures of Airplanes). Luigi Broglio. *Ingenieria Aeronautica*, Vol. 1, No. 2, April–June, 1949, pp. 56–59, figs. 2 references.

The Electrical Measurement of Strain. *The Engineer*, Vol. 188, No. 4899, December 16, 1949, pp. 713, 714.

Photoelasticity Procedure is Simplified with Diffused-Light Polariscope and Prepolished Materials. August J. Durelli and Rex L. Lake. *Machine Design*, Vol. 21, No. 11, November, 1949, pp. 137–141, illus., figs. 5 references.

Thermodynamics (18)

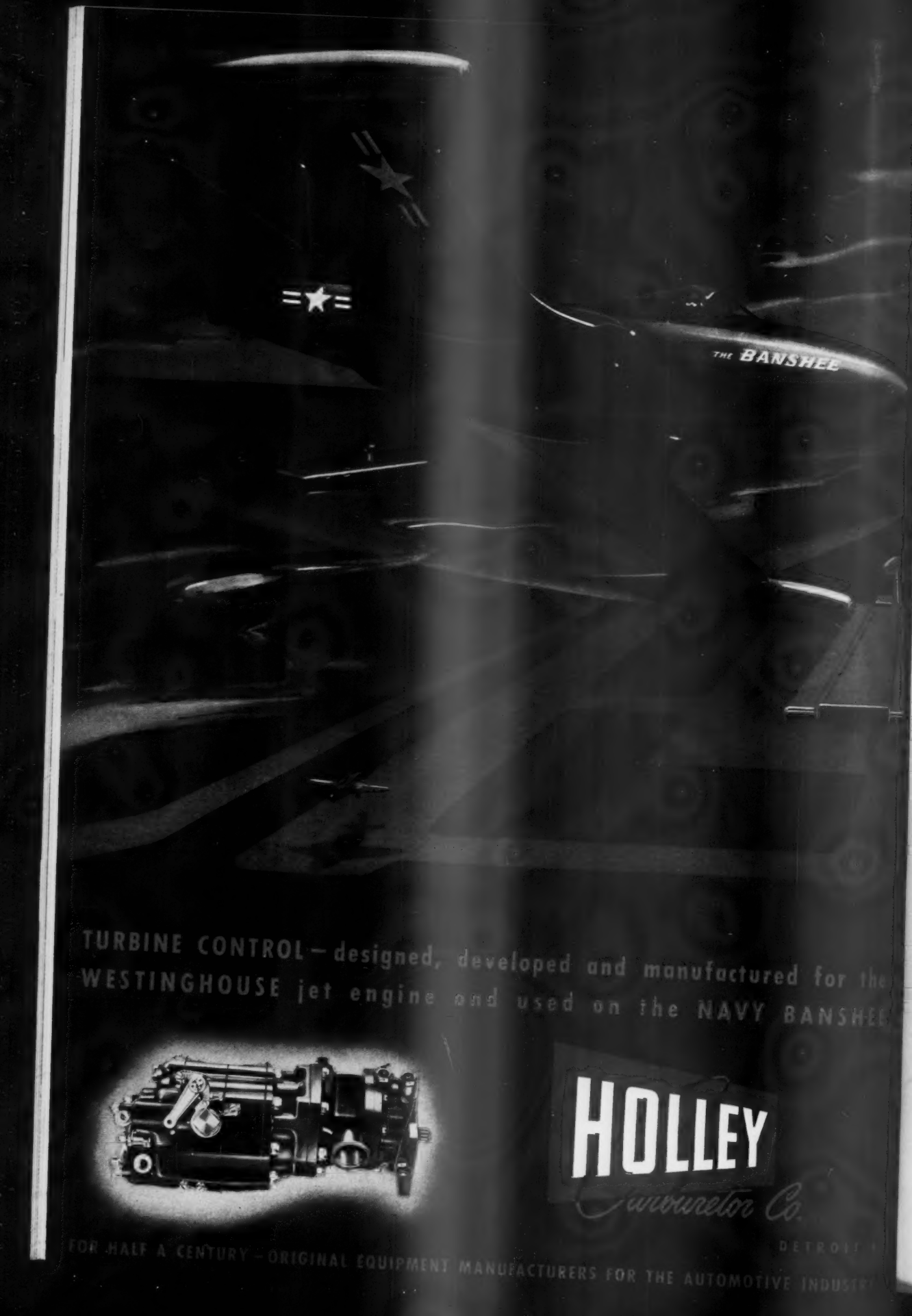
Equation of State; Generalized Correlation Applicable to all Phases. Wm. F. Rush and B. Wm. Gamson. *Industrial and Engineering Chemistry*, Vol. 41, No. 1, January, 1949, pp. 78–81, figs. 12 references.

An equation of state applicable to liquid, vapor, and uniform phase was developed by McLeod for use in problems relating to vapor-liquid equilibria and the thermodynamic properties of materials. A correlation is presented in the present paper which permits the evaluation of the constants of the McLeod equation with knowledge only of the critical constants of the substance, eliminating the tedious trial-and-error solution of four simultaneous equations formerly required. Use of W. B. Kay's pseudocritical concept permits the extension of the correlation to mixtures. Good agreement with experimental values is obtained.

Calculation of Gas Mixture Viscosities. J. W. Buddenberg and C. R. Wilke. *Industrial and Engineering Chemistry*, Vol. 41, No. 7, July, 1949, pp. 1345–1347, figs. 22 references.

An empirical correlation to predict the constants in the Sunderland-Thiesen equation for binary gas mixtures leads to a general equation applicable to the calculation of gas viscosities for mixtures, which is based on the properties of the pure components.

(*Continued on page 88*)



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Aeronautical Reviews

Books

Airline Competition

By Frederick W. Gill and Gilbert L. Bates. Boston, Harvard University, Graduate School of Business Administration, Division of Research, 1949. 704 pp., diagrs. $5.75.

This detailed study was undertaken to determine the role of excessive air-line competition on the economic status of the United States domestic air transportation industry. It definitely shows that air-line bigness does not necessarily connote low cost operation.

The economic analysis of the air carriers, collectively and by group, showed that multiple carrier competition has been the major flaw in the competitive expansion of the domestic air transportation system during the last twelve years, and that "if air transportation is to attain a status of self-sufficiency and to carry its fair share of the cost of operating airways and airports, it must be allowed to earn a profit where this is possible unless definitely against the public interest."

While the authors of this book state that their study is an "impartial, factual review" of the development of competition and its effect on the air carriers, it, nevertheless, points out that competition has often been a "double-edged sword" in that it sometimes impaired service to the public and lowered profits rather than built up traffic potential and promoted progressive developments.

The study on the history and nature of air fares has been well presented and discussed.

In comparing the four largest domestic air carriers, this reviewer does not believe that the authors sufficiently emphasized the necessity for efficient air-line management and somewhat unfairly compare the most successful of the Big Four to the three others.

Minor errors have been detected, such as the statement to the effect that the Boeing Stratoliner was the first four-engine plane to be flown in the United States in domestic commercial service. This is not accurate in that the first four-engine transport in operation domestically was the Fokker F-32 operated in 1930 between Los Angeles and San Francisco. This is pardonable, however, in a study so extensive as this book and does not detract from its intrinsic value.

Airline Competition is a book which should be read by everyone concerned with economics in the air transport industry, as well as by its engineering personnel.

CHARLES FROESCH
Chief Engineer
Eastern Air Lines, Inc.

Air Transportation

By G. Lloyd Wilson and Leslie A. Bryan. New York, Prentice-Hall, Inc., 1949. 665 pp., illus. $5.75.

In an industry which has developed as rapidly as that of air transportation, it is easy for the history of accomplishments of the field to become lost in the forward rush of progress. A book such as *Air Transportation* does much toward formally establishing history of the industry as well as making available for the student lessons which are to be learned from the past and present status of air transportation. The authors, Wilson and Bryan, have done a most comprehensive job of documenting the development of our commercial air lines as we know them today, going back in detail to the 1920's and also generally covering the early period in aviation, both practical and visionary.

In the documentary field, the book is of such value as to be a must in every air transport library—public, commercial, and private. Statistical information on passengers, freight, mail, and other air-line information goes back to the middle 1920's to give a full story on trends and rates of growth.

One of the most important features of the book is its treatment of organization, operation, and detailed procedures of modern air transportation. It is here that the student, whether presently employed or preparing to become an air-line employee, will find the greatest benefit in obtaining a broad picture of the air transportation industry as it exists today. The following chapter headings from the total of 37 chapters will give an indication of the scope covered in this 665-page book: Airports—Operation and Management; Domestic Airlines in the United States; Air Passenger Transportation; Domestic Air Freight or Cargo Services; Coordination in Air Transportation; Liability of Carriers by Aircraft; Safety in Air Transportation; Employee and Public Relations in the Air Transportation Industry; Local or Municipal Air and Regulation; and Federal Regulation of Aviation and Air Transportation.

The book is worth reading and deserves a place on any reference shelf which purports to cover air transportation.

R. DIXON SPEAS
Assistant to the President
American Airlines, Inc.

For information on I.A.S. Library Service Facilities, see page 55

Statements and opinions expressed in Book Reviews are to be understood as individual expressions and not necessarily those of the Institute.

Private Flying, Today and Tomorrow

By William T. Piper in collaboration with D. J. Duffin. New York, Pitman Publishing Corp., 1949. 282 pp., illus.

In a rather small book Mr. Piper and Mr. Duffin have combined wide reader appeal and interest for the expert; broad coverage and an amazing wealth of material. They have, I feel, produced a book which few interested in light-plane aviation will care to miss.

We may classify its contents into matter dealing with the past, the present, and the future. From his own experience in the birth and infancy of the light-plane industry in this country, Mr. Piper puts together a charming story which will bring nostalgic memories to others who participated in the era. His chapter on the ladies in early and light aviation intended to encourage feminine users falls short in only one respect. He fails to explain why all the ladies quit flying so young. The cause might, of course, be the East Coast weather he mentions since most of them hailed from this section. We may hope that the Southwest where he looks for the most rapid development will keep its ladies in the air to a riper age.

In dealing with the today of light-plane aviation, Mr. Piper is as sound as the plane he builds. Pilots with cross-country experience in this class of aircraft will recognize only too well his telling analysis of the present shortcomings. On the brighter side,

the homey personal touch with which he clothes the dry bones of the long road to improvement should inspire every local aviation group in the country. The description of the growing practical utility of the light plane in the farm country will surprise many of its adherents who have thought of it essentially as a pleasure craft.

Into this picture of the present is painted a fine survey of the light-plane manufacturer's offerings. For those who own or fly, or plan to do either, this section should be invaluable. It includes a study of flying costs and a chapter on the art. Club plans are included in the study.

To the difficult art of forecasting the future the author brings as qualification the reputation for sound and conservative thinking. His approach is refreshing, for he takes definite stands on controversial issues and gives his reasons for so doing. For example, he prefers the three-control system to the two-control system. I have no doubt that some proponents of the helicopter, all those favoring the convertiplane, and the few ornithopter addicts will wish to read the book so as to take proper issue with Mr. Piper.

. Mr. Piper sees little future for the light plane in the most heavily populated sections in the country. His opinion is of course based upon the present state of aeronautic development in this field. It may well indicate the need for major research efforts directed solely to light-plane needs. A backview over the last half century might indicate that the light-plane researchers have been too bandwagonish in following heavy military and commercial trends. We have, in addition, abandoned too many half-explored trails.

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Plasticity in Engineering

By F. K. Th. van Iterson. Glasgow, Blackie & Son, Ltd., New York, Hafner Publishing Co., Inc., 1948. 174 pp., diagrs. $2.50.

The kind of plasticity discussed in this book is that of the flat-topped stress-strain diagram. This automatically excludes many of the inelastic phenomena that are of great interest to aeronautical engineers (for example, inelastic buckling and creep). On the other hand, the simplification made possible by the assumption of ideal plasticity permits the solution of a large number of practical problems of considerable interest. Particularly revealing are the many diagrams of the plastic zones which occur under various types of loading and geometrical configurations. For example, the analysis of a mass compressed between parallel planes brings out many ideas which might be useful in the design of large structural components to be made by press forging.

The importance of verifying theories by means of actual experiments is emphasized, and the results of various tests are presented. Some of the text setups are cleverly designed so as to reveal, by the location of the failure, the nature of the underlying phenomena.

The treatment of combined stresses makes clear several important facts that should be understood by every structural engineer. For example, under certain conditions it is possible to exceed the yield point in simple tension, even for the ideally plastic material. The brittle behavior of ductile materials under triaxial tension loading is demonstrated, as well as the ductile behavior of brittle materials under certain loading conditions.

The author repeatedly asserts that slip planes do not occur in plastic flow. Although it may be misleading to imagine slip planes in *idealized* plastic flow there is much evidence to indicate that most inelastic effects are associated with slip planes. It is difficult for the engineer to accept, as a law of physical behavior, a statement which appears to be based on an idealization, especially when this idealization does not apply with any accuracy to materials such as aluminum alloys or heat-treated steel. The peculiar characteristics of low-carbon steel seem to have had a profound effect on the development of the theory of plasticity. It should be noted that the author points out (p. 124) that if strain-hardening exceeds 15.7 per cent the law of flow is different from that on which this treatise is based.

In the last chapter a number of tests of columns are described, the results of which lead to the conclusion that the buckling stress cannot exceed the yield point. This "law for plastic flexure" can be explained by the principles outlined in "Inelastic Column Theory" (Journal of the Aeronautical Sciences, May, 1947). It would not be true, however, for the buckling of plates with supported edges, nor for shells. It is to be hoped that some of the other laws of plasticity are of a more fundamental nature!

F. R. SHANLEY
Consultant
The RAND Corporation

Book Notes

AERONAUTICS, GENERAL

The Airplane and Its Engine. C. H. Chatfield, C. Fayette Taylor, and Shatwell Ober. 5th edition. New York, McGraw-Hill Book Co., Inc., 1949. 380 pp., illus., diagrs. $4.50.

The last revision of this standard work was published in 1940. This edition retains the original purpose of presenting the basic principles and a broad view of the development of the airplane and its power plant. The treatment is still largely nonmathematical, but simple algebraic equations have been added in this edition in appropriate parts of the discussion. Practically all of the descriptive material has been revised and a new separate chapter on gas turbines and rocket engines has been added. The bibliography has been brought up to date and includes 78 books and articles.

AIRPLANE DESIGN

Method of Presentation of Data for Proposed Aircraft. Revised edition. Washington, D.C., Air Transport Association, 1949. 56 pp., diagrs.

This is the first revision of this document since it was first issued in 1944. Performance Analysis data required have been expanded to include data on propeller reversals, runway gradient, temperature accountability, and three engine ferry operations, and jet thrust (if used) has been added to the engine requirements. The greatest changes are in the Direct Operating Cost data, which have been revised in regard to such items as reserve fuel, baggage weight, wind correction, and cruising altitudes for pressurized and unpressurized aircraft. While the basic form of the original equations has been retained, the equations now give airplane costs in terms of cost per mile instead of cost per ton mile. A second major change provides for revision and rearrangement of the equations to coincide with the latest CAB System of Accounts.

AIRPORTS

Air Touring Guide to Europe, 1949–50. London, The Royal Aero Club Aviation Centre, 1949. 221 pp., illus., maps. 8 *s.*

While the greater part of this book is devoted to details of airports, radio facilities, landing and hangar fees, and refuelling costs in 16 European countries, the first 55 pages contain detailed flight planning information. How to secure documents, maps, and airport information, health and currency regulations, outline maps and tables of distances of suggested routes, conversion tables, sunrise and sunset tables, and an international vocabulary of aviation are among the information included. This Guide is issued under the auspices of the Private Aviation Division of the International Aeronautic Federation.

ELECTRONICS

Aerials for Metre and Decimetre Wave-Lengths. R. A. Smith. Cambridge and New York, Cambridge University Press, 1949. 218 pp., illus., diagrs. $3.75.

The range of wave lengths for aerials that are discussed in this volume is between 12 m. and 1 m. with a short chapter on aerials in the 1 m. to 10 cm. range. A selection from the many arrangements of aerial systems is described to illustrate general principles, most of them from the field of radar. Resonant dipoles, aerial arrays, and fundamental theory are discussed in the beginning chapters, proceeding into transmitting and receiving aerials, and long-wave, Yagi, aircraft, wide-band, and slot aerials. The final chapter deals with noise in aerials. The author is superintendent of the physics department of the Telecommunications Research Establishment, British Ministry of Supply.

ENGINEERING PRACTICES

Mechanical Engineering Practice, a Laboratory Reference Text. Charles F. Shoop and George L. Tuve. 4th edition. New York, McGraw-Hill Book Co., Inc., 1949. 513 pp. illus., diagrs. $4.50.

In this new edition of a textbook last revised in 1941, the text has been rewritten to include new material on instrumentation, the characteristics of automatic controls, heat-power technology, measurements of the properties of fluids, combustion and fuels, and heating, ventilating, and air conditioning. The number and diversity of experiments have been increased, including such advanced subjects as the measurement of radiation, the use of the oscilloscope for mechanical measurements, the measurement of aerodynamic drag and lift, and the analysis of air distribution in ventilation. The authors are professors, respectively, at the University of Minnesota and the Case Institute of Technology.

MAINTENANCE

Aircraft Maintenance and Service. Rollen H. Drake. New York, The Macmillan Co., 1949. 352 pp., illus., diagrs. $6.00.

The author's aim is to present the fundamentals of aircraft repair and servicing in nontechnical language, for the mechanic, student, and teacher, including rules of inspection, choice of woods, metals, and alloys, and the special techniques required for each. A separate chapter is included on the light airplane, and most of the illustrative material deals with light airplanes. Approved repairs as required by the Civil Aeronautics Administration are given particular attention.

MATERIALS

Hardenability and Steel Selection. Walter Crafts and John L. Lamont. New York, Pitman Publishing Corp., 1949. 279 pp., illus., diagrs. $5.50.

The authors' aim is to consolidate and summarize into a coordinated pattern the known facts and theories of hardenability. The underlying principles are presented for the student or engineer, and the whole pattern of hardenability equations, tables, and graphs is assembled for ready reference by the metallurgist, materials engineer, or designer who is responsible for the selection and heat treatment of steel. A bibliography of 139 items and author and subject indexes are included.

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The authors are chief metallurgist and research metallurgist, respectively, with the Union Carbide and Carbon Research Laboratories, Inc.

Sound Absorbing Materials. C. Zwikker and C. W. Kosten. New York, Elsevier Publishing Co. Inc., 1949. 174 pp., diagrs. $3.00.

The properties are examined which impart sound-absorbent qualities to materials of construction. Methods of prediction of the sound-absorbing behavior of a surface from such mechanical factors as porosity, compression modulus, air-resistance, and shape are examined, and the importance of acoustic impedance is stressed in a separate chapter. The principles of wave propagation in porous media are thoroughly examined, and experimental data are compared with theoretical data. Sound absorbers of the resonator type are discussed from the practical design point of view, and a final chapter deals with the practical aspects of oblique and random incidence. Footnote references are included throughout. The authors are associated, respectively, with Philips Electrical Industries and the Delft Technical University.

MILITARY AVIATION

Air Power and Unification. Louis A. Sigaud. Harrisburg, Pa., The Military Service Publishing Co., 1949. 119 pp. $2.50.

Following an examination of the unification problem in the U.S., the air-power principles of General Giülio Douhet are explained, then these principles are applied to the unification problem. Carrier-based bombers for the precision bombing of military targets, in support of such bombing by the Air Force, are considered more important than improvement of the B-36 bomber ,or fighter escorts for the B-36, and a more adequate role for the surface arms with enough auxiliary and cooperative aviation for their functioning, is suggested. Special problems, such as the need for better liaison between foreign policy and national military power, are also considered.

The Red Army Today. Louis B. Ely. Harrisburg, Pa., The Military Service Publishing Co., 1949. 256 pp., illus. $3.50.

Colonel Ely's description of the Soviet military machine is based upon information obtained from the large number of Red Army men who have chosen to take up life in the Western world, and to some extent upon translations from Russian military periodicals. The main strength of the Red Army lies in its size, the excellence of its tanks and short-range artillery, and in the policy of air support for its ground operations. The air force, as well as the artillery, is intended first of all as support for the ground forces.

PERSONAL FLYING

Private Pilot's Handbook. A. G. Norwood. 2nd edition. New York, Pitman Publishing Corp., 1949. 300 pp., illus., diagrs. $4.50.

In this new edition of a book first published in 1942, new material has been added and the entire text rearranged and revised. The two-control airplane, lateral stability, icing, thunderstorms, and isobaric forms are typical of subjects newly introduced or expanded. The chapter on navigation has been expanded, and new chapters added on radio navigation, celestial navigation, control tower procedure, aircraft computers, practical navigation, instrument flying, the flying club, and safety inspection. Chapters on the flight test and on civil air regulations have been rewritten and expanded.

POWER PLANTS

JET & TURBINE

Jet Aircraft Simplified. Charles Edward Chapel. Los Angeles, Calif., Aero Publishers, Inc., 1950. 160 pp., illus., diagrs. $3.75.

Following a brief historical introduction, the principal types of jet propulsion are explained, typical turbojet engines in production are described in detail, and airplanes powered by the J33, J34, and J35 turbojets are reviewed. The prop-jet and various existing composite power arrangements are discussed next, followed by

chapters on rocket-powered guided missiles, rocket-powered airplanes, and a final chapter on recent jet aircraft progress. A detailed index is included, and the book is well illustrated by photographs and drawings.

REFERENCE LITERATURE

DICTIONARIES & ENCYCLOPEDIAS

Engineers' Dictionary; Spanish-English and English-Spanish. Louis A. Robb. 2nd edition. New York, John Wiley & Sons, Inc., 1949. 664 pp. $12.50.

This new edition of a dictionary first published in 1944 contains more than 10,000 additional terms. The fields of electrical and mechanical engineering are covered more thoroughly than in the first edition. Terms in the fields of radio and television, not covered in the first edition, and in such special fields of civil engineering as photogrammetry, airport construction, and soil mechanics, have been added, along with new terms in other technical fields. The scope of the first edition has been increased, but the purpose of the dictionary is the same—to furnish English and Spanish equivalents of terms in actual technical use.

Scientific and Technical Abbreviations, Signs and Symbols. O. T. Zimmerman and Irvin Lavine. 2nd edition. Dover, N.H., Industrial Research Service, 1949. 541 pp., diagrs. $8.00 in the U. S.; $9.00 overseas.

Since the first publication of this useful work in 1948, new American Standards have been published for symbols in aeronautics and aerodynamics, physics, and electrical quantities, and revisions of other standards. Among other new tables in this edition are abbreviations for civil aircraft types, symbols and figures for the International Weather Code, letter symbols used in weather reporting, and abbreviations of military organizations. Revisions have been made in a number of tables, including those of mathematics, mechanics of solid bodies, engineering drawings, welding, aeronautics, and meteorology.

HISTORY

To the Moon and Halfway Back. Roger Q. Williams. San Angelo, Texas, Newsfoto Publishing Co., and Oakland, Calif., Arque Aviation Press, 1949. 292 pp., illus. $6.00.

Colonel Williams took his first airplane ride at Sheepshead Bay in 1910, taught himself to fly in 1914, obtained pilot's certificate No. 300, and became a test pilot. His career has included tours of duty in two world wars, barnstorming, manufacturing, flight instruction, and record flights from New York to Rome in 1928 and from New York to Bermuda and return in 1930. This history is written from the point of view of the pilot and offers the reader an entertaining view of the aviation record which is always refreshing because it is told by a man who was either there himself or knew the pilots who were there. The main deficiency of the book is in the author's modesty in identifying himself, and the lack of definite names in the text. The behind-the-scenes reporting of flights of the 1920's, such as the German fact-finding flights, and the report of flying in World War II in Alaska, are well worth the reader's time.

YEARBOOKS

Jane's All the World's Aircraft, 1949-50. London, Sampson Low, Marston & Co., Ltd., New York, McGraw-Hill Book Co., Inc., 1949. 462 pp., illus. $16.00.

Jane's continues to hold its position as the best annual survey of the world's aircraft. This year's edition celebrates a new American publisher and measures up fully to the quality of its predecessors, with some improvements. The sections on civil and military aviation and on airplanes, are presented three columns to the page this year instead of two, allowing for economy in the tabulation of the standard airplane descriptions, and more information in less space. About 85% of the 542 illustrations are new. The airplane section, as always, is the largest in the book. Nearly 290 pages are devoted to airplanes, with the U.S., Great Britain, and France leading in the number of pages needed for their productions. Russia takes up 14 pages, four of them dealing with new jet bombers and fighters. The indexes of airplanes and engines, preceding their respective sections, begun last year, are continued, and the introductory pages include reviews of 40 years of flight by Sir Frederick Handley Page and Glenn L. Martin, as well as a history of *Jane's* itself during its first 40 years.

SCIENCES, GENERAL

PHYSICS

Vacuum Equipment and Techniques. Edited by A. Guthrie and R. K. Wakerling. New York, McGraw-Hill Book Co., Inc., 1949. 264 pp., illus., diagrs. $2.50.

This volume deals with the studies and developments of high-vacuum equipment and practice at the University of California Radiation Laboratory in cooperation with the Manhattan District. An introductory chapter on fundamental considerations and appendix tables of data have been included. The elements of the vacuum system, vacuum gages, vacuum materials and equipment, and leak-detection instruments and techniques are among the topics discussed.

THERMODYNAMICS

Radiant Heating. T. Napier Adlam. 2nd edition, revised and enlarged. New York 13, The Industrial Press, 1949. 504 pp.. illus., diagrs. $6.00.

In this edition of a book first published in 1947, about 32 pages of new material have been added, especially in the sections on radiant heating with ceiling and floor panels, and on wall, baseboard, electrical, and metal panels. The material has been rearranged, and the original aim of providing a guide to the solution of actual problems is retained.

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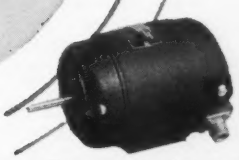

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News of Members

(*Continued from page 26*)

Wing, Tyndall Air Force Base, Panama City, Fla., was transferred from Edwards Air Force Base, Muroc, Calif.

William D. van Zelm, M.I.A.S., resigned from his position as Chief of New Design at The Glenn L. Martin Company, Baltimore, Md., to form a consulting engineering firm with offices in Baltimore.

David W. Whittlesey is Application Engineer for Berry Motors, Inc., Corinth, Miss.

Charles J. Wirth, T.M.I.A.S., is a Junior Engineer, Aircraft Design Department, at A. V. Roe Canada Ltd., Malton, Canada. New address is 71 Edna Ave., Toronto, Ontario, Canada.

Members Elected

The following applicants for membership or applicants for change of previous grade have been admitted since the publication of the list in the last issue of the REVIEW.

Elected to Associate Fellow Grade

Arnold, Milton W., M.S. (Meteorology), Vice-President of Operations & Engineering, Air Transport Assoc. of America.

Bioletti, Carlton, B.S., Asst. to the Dir., Ames Aero. Lab., N.A.C.A.

Transferred to Associate Fellow Grade

Brierton, James L., B.S. in C.E., Engineer—Designer "A," Consolidated Vultee Aircraft Corporation (Ft. Worth).

Fairchild, Sherman M., Chairman of the Board, Fairchild Camera & Instrument Corporation; Head, Sherman Fairchild & Assoc.

Jerger, Joseph J., Consulting Engineer reporting to General Mgr., Missiles Div., Fairchild Engine & Airplane Corp.

Lusty, Cameron N., B. of Ae.E., Chief Engineer, Aircraft Div., Globe Corp.

Ramberg, Walter, Dr. Sc., Chief, Mechanics Div., National Bureau of Standards.

Rogallo, Francis M., M.E. (Aero.), Head of 7 × 10 Ft. Tunnel Branch, Stability Research Div., N.A.C.A., Langley Air Force Base.

Seltzer, Leon Z., B.S. in Ae.E., Prof. & Head, Department of Aero. Engineering, West Virginia University.

Elected to MEMBER Grade

Asch, Abraham B., B.S. in M.E.

Barkey, Herman D., B. of Ae.E., Project Engineer, McDonnell Aircraft Corp.

Bellin, Albert I., Ph.D. and M.A., Asst. Prof. of Engineering Science, Harvard University.

Benedict, John T., B.Ae.E., Asst. Editor, Rogers Publishing Co.

Bothwell, Douglas, B.S. in Chem. Engineering, Service Engineer, Contracts Administration, Douglas Aircraft Co., Inc. (Santa Monica).

Farquhar, Gordon L., Equipment Group Engineer, Douglas Aircraft Co., Inc., (Santa Monica).

Faulkner, John F., B. of Ae.E., Engineer, Development Div., Aircraft Section, Aluminum Co. of America.

Fleming, Frank N., Project Engineer, Douglas Aircraft Co., Inc. (Santa Monica).

Hubbard, Norman A., B.S.Ae.E., In Charge of Aero. Engineering, Engineering & Research Corp.

Langford, A. F. W., Sr. Development Engineer, Tiltman Langley Labs., Ltd.

Nelson, Henry O., B.S.M.E., Asst. Aero. Engineering Officer, Overhaul & Repair Department, U.S. Naval Air Station (San Diego).

Parker, Norman F., D.Sc., Research Engineer "A," North American Aviation, Inc.

Schalin, Pehr Harald B., B.S. in Aero. & Mech. Engineering, Project Engineer, SAAB Aircraft Co.

Vaughn, Margaret E., Basic Instrument Flight Instructor, Aviation Training Staff, Inst. Training Lab., C.A.A. (Washington).

Wells, Edward L., B.S. in M.E., Sr. Engineering Draftsman, The Glenn L. Martin Co.

Transferred to MEMBER Grade

Block, David S., B.S. in Ae.E., Instructor, The Aero. University, Inc.

Center, Kenneth W., B. of M.E., Research Engineer, Grumman Aircraft Engineering Corp.

Dolfi, Harry W., M. of Engineering in Ae.E., Stress Analyst, Douglas Aircraft Co., Inc. (Santa Monica).

Hook, Franklin Lewis, B.S. in Ae.E., Flight Test Group Engineer, The Glenn L. Martin Co.

LaVene, Clayton C., Employment Mgr., Engineering Div., Douglas Aircraft Co., Inc. (Santa Monica).

McCormick, Gordon Hugh, B.A.E., Lt. (j.g.), U.S.N.; Trainee, Heavier than Air Flight Training, Naval Air Station (Pensacola).

Nucci, Louis M., B.S. in M.E., Aero. Research Scientist, N.A.C.A., Langley Air Force Base.

O'Donnell, Frank H., B. of Ae.E., Research, Design & Development Engineer, Massie Memorial Wind Tunnel, Wright-Patterson Air Force Base.

Sleeman, William C., Jr., B.S. in Ae.E., Aero Research Engineer, 7 × 10 Ft. Wind Tunnel, N.A.C.A., Langley Air Force Base.

Wilson, Allan Eugene, B. of Ae.E., Stress Analyst "B," Douglas Aircraft Co., Inc. (El Segundo).

Transferred to Associate Member Grade

MacFarland, Harvey W., Asst. Purchasing Agent, Permatex Co.

Elected to Technical Member Grade

Addison, James C., B.S. in Engineering Sc., Aero. Engineering Instructor, Embry-Riddle School of Aviation.

Calhoun, James W., B. of M.E., Instructor, Engineering Department, University of Virginia.

Dianish, Joseph J., Project Engineering Supervisor, O. & R. Department, Engineering Group, U.S.M.C.A.S. (Cherry Point).

Diehl, Zulime W., A.B., Physicist (Aerodynamicist) P-2, Aerodynamics Section, National Bureau of Standards.

Taylor, Harvey L., B.S.Ae.E., Structures Engineer, Bell Aircraft Corp.

Van Nimwegen, Robert, B.S. in M.E., Stress Analyst, Douglas Aircraft Co., Inc. (El Segundo).

Transferred to Technical Member Grade

Bajek, Julius J., B.S. in Ae.E. & Admin. Engineering.

Benefield, Tommie D., B.S. in Ae.E., 2nd Lt. & Student Officer, U.S.A.F., Perrin Air Force Base.

Benepe, David B., B. of Ae.E., Teaching Fellow & Graduate Student, University of Notre Dame.

Bonfiglio, Joseph R., B.Ae.E., Engineer Chrysler Corp.

Brecheen, B. H., A.A. in Ae.E., Engineering Draftsman, Consolidated Vultee Aircraft Corp. (Ft. Worth).

Carlton, Lindley A., B.S., Mathematician "A," Stress Group, North American Aviation, Inc.

Chwalek, Richard J., Engineering Draftsman, Bendix Products Div., Bendix Aviation Corp.

Cobb, William A., B.S., Lt., U.S.A.F.; Jet Fighter Pilot, Sq. Supply & Asst. Engineering Officer, Furstenfeldbruck Air Force Base.

Deveikis, William D., B.S. in Ae.E.

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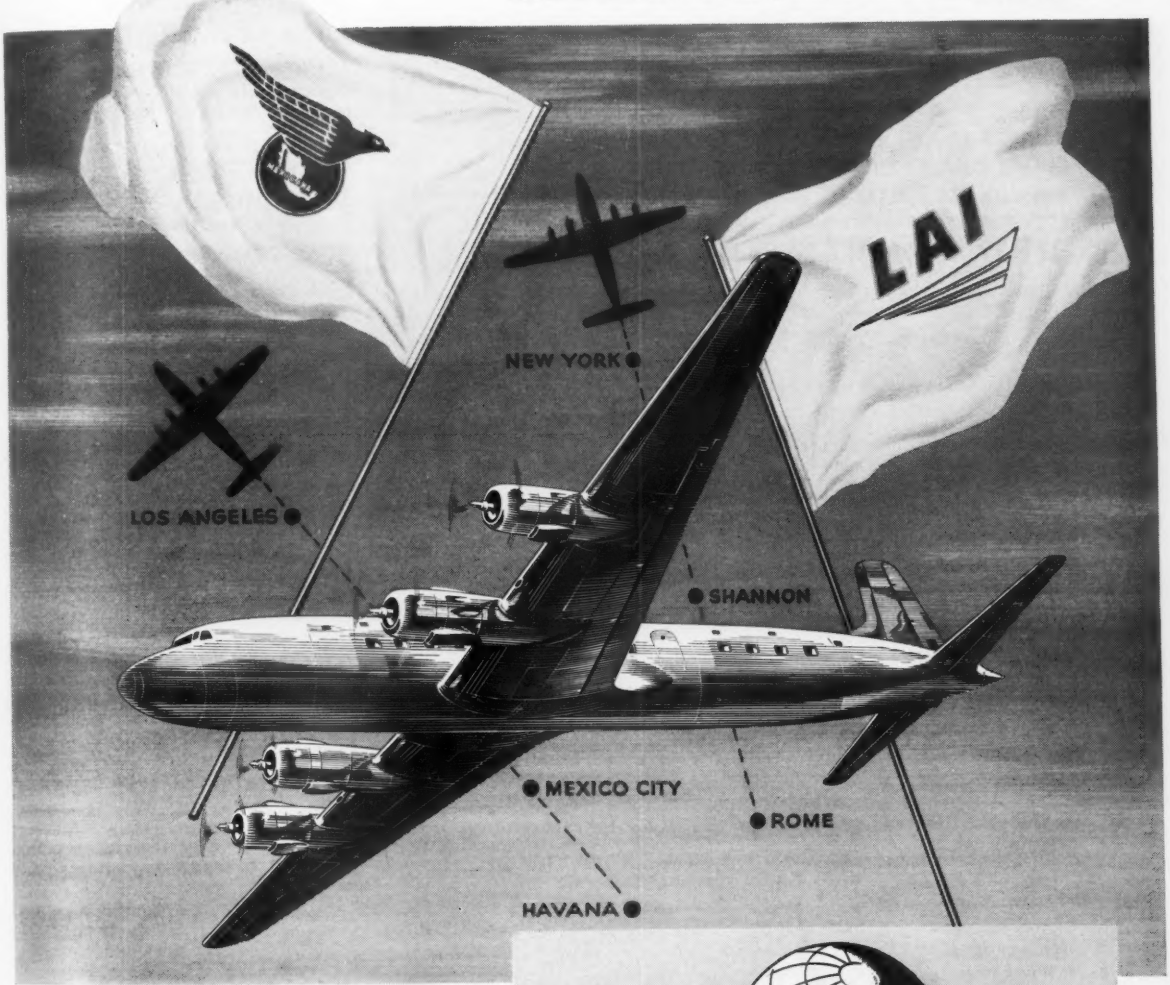

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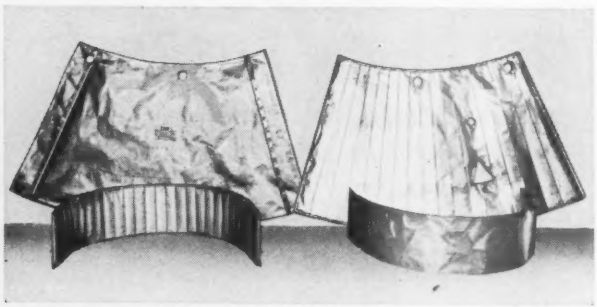

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Eastman, Phillips, Jr., B.S., Capt. and Pilot, U.S.A.F.

Elliott, Eugene W.

Endreikis, Irene J., B. of Ae.E.

Foster, Robert D., B.S., Graduate Student, Massachusetts Institute of Technology.

Goddard, Vincent P., B.S.Ae.E., Instructor in Aero. Engineering, University of Notre Dame.

Gomme, Gerald E., Project Engineer, Technical Training Aids, Inc.

Harlin, Robert E., B.Ae.E., Draftsman, North American Aviation, Inc.

Harris, Gail, A.A. in Ae.E., Asst. Engineer, Technical Training Aids, Inc.

Havel, Robert J.

Heilenday, F. W., Jr., M.S., Aerodynamicist, Consolidated Vultee Aircraft Corp. (Ft. Worth).

Hester, Henry E., 1st Lt. and Pilot, U.S.A.F.

Hunter, John R., B.S., Jr. Engineer "B," Boeing Airplane Co. (Seattle).

Huot, Raymond J., Engineering Draftsman "A," Hughes Aircraft Co.

Isenberg, Jack M., B. of Ae.E., Jr. Engineer "B," Boeing Airplane Co. (Seattle).

Jackson, Lloyd E., B.S. in Ae.E., Engineering Trainee, Chance Vought Aircraft Div., United Aircraft Corp.

Knapp, Clyde H., Jr., B.S.Ae.E., Lt., U.S.A.F.; Aircraft Maintenance Procurement Officer, Hq., Air Materiel Command, Wright-Patterson Air Force Base.

Laber, Robert H., A.A. in Ae.E., Draftsman, Technical Training Aids, Inc.

Laufer, John, Ph.D. in Aero., Physicist, National Bureau of Standards.

Linsley, Edward L., B.S. in Ae.E., Aero. Engineer, N.A.C.A., Langley Air Force Base.

McAnally, Bill M., Engineering Draftsman "B," North American Aviation, Inc.

Miller, Frank H., B.S.Ae.E., Flight Test Analyst, North American Aviation, Inc.

Mracek, Milo F., B.S.Ae.E., Engineering Trainee, Processing Dept., McDonnell Aircraft Corp.

Paulson, Lee C., M.S. in Ae.E., Instructor, Dept. of Mech. Engineering, New Mexico College of A. & M.A.

Payne, William J., B.S.Ae.E., Student Officer, U.S.N.; Naval Aviation Cadet, Naval Air Station (Pensacola).

Pearson, Donald L.

Peterson, Vern F., Captain and Engineering Officer, 8th Fighter Group, U.S.A.F.

Rice, Louis J., B.Ae.E., Sales Engineer, Ex-Cell-O Corp.

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Salter, Thomas R., M. of Engineering, Aero. Engineer—Aerodynamics, Douglas Aircraft Co., Inc. (El Segundo).

Schueler, Clarence J., A.A. in Ae.E.

Schwartz, E., B.S.Ae.E., Engineer—Pilot, Flight Test Analyst, Consolidated Vultee Aircraft Corp. (San Diego).

Singer, Edward, B.S.Ae.E., Jr. Engineer—Draftsman, A. V. Roe Canada, Ltd.

Skene, William T., B.S. in C.E. (Aero.), Structural Engineer, Aerophysics Lab., North American Aviation, Inc.

Smith, William F., Jr., M.S. in Ae.E., Instructor in Mech. Engineering, New Mexico College of A. & M.A.

Smithson, John L., B.S., Graduate Student, Oregon State College.

Taft, Royal C., Jr., B.S.M.E.

Watson, James J., B.S. in M.E., Aviation Cadet, U.S.N.

Welsh, Clement J., B.S.Ae.E., Aero. Engineer, Pilotless Aircraft Div., N.A.-C.A., Langley Air Force Base.

Wenzel, James G., B. of Ae.E., Student & Research Asst., University of Minnesota.

Whitney, Yenwith K., S.B., Student, Polytechnic Institute of Brooklyn.

Wiener, Harry E., B.S.Ae.E., Cargo Sales Representative, Northwest Airlines.

Winegar, William L., B.E., Design Engineer "C," Studies Group, Aerojet Engineering Corp.

Witkowski, Stanley J., Jr., B.S.Ae.E.

Woirol, Warren S., A.E., Capt., U.S.-A.F., Keesler Air Force Base.

Last Chance for Roster Listing

In order that the 1950–1951 ROSTER OF MEMBERS be as complete and accurate as possible, a last call is being issued for latest data concerning present employment and titles, company addresses, and preferred mailing addresses of I.A.S. members.

This is your last opportunity to be correctly listed in the 1950–1951 I.A.S. ROSTER. Some members have failed to send in their completed roster cards, and for this reason we have extended the original deadline date to MARCH 30, 1950, after which no further returns can be accepted. Make sure that the roster card previously mailed to you for completion is filed before that date.

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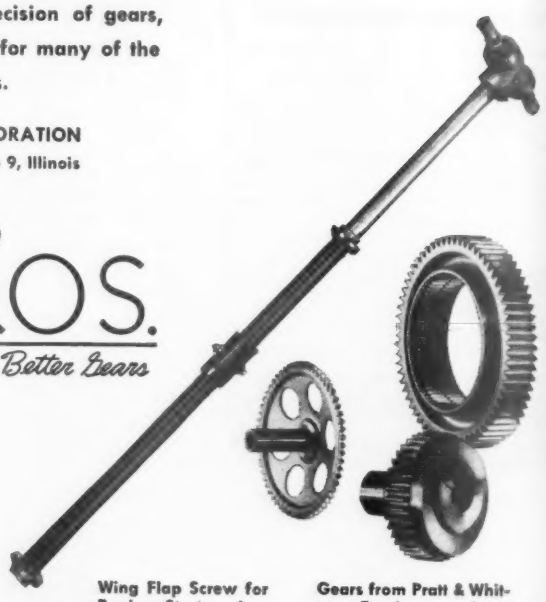

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Personnel Opportunities

This section is for the use of individual members of the Institute seeking new connections and organizations offering employment to Aeronautical specialists. Any member or organization may have requirements listed without charge by writing to the Secretary of the Institute

WANTED

Aeronautical Engineer or Aerophysicist—M.S. or Ph.D. Conduct proposal design studies for supersonic missiles and aircraft rockets. Studies to be of theoretical nature and will involve a large amount of higher mathematics. It will be necessary to carry to completion projects of a moderate scope with a minimum amount of supervision. Aerojet Engineering Corporation, P.O. Box 296, Azusa, Calif.

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Preliminary Design Engineer—Five to 10 years' engineering and design experience, with engineering degree, to aid in preparation of proposals on accessory drives, fuel metering equipment, and ram-jet development programs. Must be capable of analytical solution to design problems and possess inventive ability. Positions available with progressive young company on West Coast for qualified persons. Salary dependent upon qualifications. Marquardt Aircraft Company, 7801 Hayvenhurst Ave., Van Nuys, Calif.

Mechanical Engineers—For Research and Development work on Chemical Process Equipment and Scientific Instruments. One Senior Engineer with advanced degree and experience required to take charge of important project. Junior Engineers required for assistants. These are permanent positions for engineers of exceptional ability and inventiveness. Salaries open. The Sharples Corporation Research Laboratories, 424 West Fourth St., Bridgeport, Pa.

Physicist—For design and development of electronic and mechanical instrumentation equipment used in the pursuit of flight-research work. Several years of theoretical and practical experience necessary. Salary commensurate with qualifications. Permanent position. Give details in first letter. Cornell Aeronautical Laboratory, Inc., 4455 Genesee Street, Buffalo 21, N. Y.

Research Assistant—A half-time research assistantship, paying about $112 per month and sponsored by the N.A.C.A., is available in the Department of Engineering Mechanics at the Pennsylvania State College starting February 1, 1950. The work deals with the experimental and theoretical study of behavior of metals subjected to combined stresses in the plastic range. The research work could be used for a Master's or Doctor's thesis in Engineering Mechanics. If interested, please write to Professor Joseph Marine, Department of Engineering Mechanics, The Pennsylvania State College, State College, Pa.

Professor of Aeronautical Engineering—To teach senior and graduate work in aerodynamics, aircraft design, and compressible fluids; conduct research. Administrative and wind-tunnel experience desirable. Degrees: Ph.D., D.Sc., or equivalent. Salary open. Address: Department of Aeronautical Engineering, University of Minnesota, Minneapolis 14, Minn.

142. Sales Executive—Must have extensive sales management experience to direct and coordinate existing sales departments, each dealing in specialized technical fields in administration of Government contracts, sale of specially engineered products to aircraft manufacturers, also selling controls for industrial use, radio in personal airplanes, and sound equipment in specialized consumer fields. Must be experienced in guiding and directing advertising programs and analyzing potential markets and operating records. Technical background desirable but not essential. Good business judgment and operating and planning experience required. Our employees know of this advertisement. Location, Mid-West.

118. Laboratory Supervisor—West Coast aircraft manufacturer needs Laboratory Supervisor with broad experience in aircraft laboratory work and special ability in the field of high-temperature steel application. Knowledge of electronics also desired. Excellent living conditions, stable employment, and opportunity for advancement available. Inquiries should include education and experience summary.

AVAILABLE

145. Engineer—B. of M.E., 1949. Prior to college had served as toolmaker's apprentice; tool design experience with West Coast aircraft manufacturer. Desires location in Midwest or East with propulsion or equipment manufacturing company.

144. Engineer—Desires position in East, June, 1949, graduate, B. of M.E., Aeronautical option. Interested in propulsion work; has had special courses in related subjects, compressibilities; has had some drafting experience.

143. Mechanical Engineer—Licensed Professional Engineer. Ten years' experience; 2 years' teaching evening classes, Washington University, St. Louis, Mo. Supervisory experience includes 3 years as Chief of Airframe, 1 year as Project Engineer (Power Plant), 1 year as Group Engineer (Power Plant), 1 year as Lead Man (Power Plant and Preliminary Design). Active Wright Field and BuAer contacts 1943–1945; active C.A.A. Washington contacts 1945, 1946. Experienced in preliminary design (7 years) including practical estimations of man power (shop and engineering) and material costs. Diversified experience ranges from complete airplane and guided-missile design to components, including liquid oxygen test devices, injector plates, rocket motor shells, high-speed bearing applications, miniature power plants, and optics systems for seekers. Prefers responsible job with a small aggressive and well-financed group. Currently holds two Professional, and 6 Civil Service ratings.

141. Aviation Executive—Captain, Naval Aviator, retired in 1947; excellent health. Twenty years' experience, covering organization administration, operation, manufacturing, and sales of military and transport aircraft; air transport operating experience. Excellent contacts in Government and aviation and air transport industry. Familiar with Navy and Air Force procurement procedures; outstanding record. Past 10 years active in Washington area. Will consider Washington representation, connection East Coast aviation, or allied activity. Familiar with Europe and will consider assignment in that area.

The number preceding the notices represents the Box Number of the Institute of the Aeronautical Sciences to which inquiries should be addressed.

140. Physicist—Summer position. B. Aero. E., 1943, from New York University. Presently studying physics at Columbia University. Three and one-half years' experience in aeronautical weight engineering.

139. Aeronautical Engineer—B. Aero. E., 1948. One and one-half years' experience in stress analysis. Age 25; single; location open.

138. Aeronautical Engineer—B.S.Ae.E., Lawrence Institute of Technology, June, 1949. Two years' experience in design and construction of experimental racer; also experience with glider structures and wind-tunnel operation. Three years in Air Force as engine mechanic and flight engineer. Experienced in machine operation and machine-shop practices. Desires position as aeronautical design and development engineer, research engineer, or instructor for aeronautical subjects. Location open. Age 27.

137. Aerodynamicist — Mathematician — M.Aero.E. Five years with leading manufacturers. Original work in wing theory. Capable group leader. Age 27; married. Will relocate if necessary. Will consider research or teaching.

136. Research and Development Engineer—Structures and Aerodynamics—Sc.D. Twelve years' experience of responsible capacity in design, research, and development of aircraft components. Has spare time to consider outside assignments for research, development, design, and/or technical studies of aircraft components. Time dedicated to these projects would ensur prompt service.

135. Associate Professor of Aeronautical Engineering—Design and Structures Engineer—Available for employment in teaching or in industry. Scholastic record includes B.S. degree and M.S. degree from Harvard Graduate School of Engineering, with work in aeronautics and applied mechanics. Early teaching experience as graduate assistant and as part-time instructor while employed in industry. Present associate professorship at leading university, held for 3 years, includes teaching junior and senior aeronautical subjects and graduate courses in structures and aerodynamics, research as principal investigator on N.A.C.A.-sponsored project, as well as design and supervision of installation of laboratory facilities. Over 6 years of industrial experience included work on gliders, large (four-engined) and small aircraft, amphibians, and jets. Formerly chief of structures and aerodynamics on light aircraft; handled approval of important aircraft designs for C.A.A.; was both design engineer and C.A.A. and Army liaison engineer for large aircraft manufacturer.

134. Wind-Tunnel Consultant—Graduate engineer with 9 years' experience in wind-tunnel testing and design, including 3 years in supersonics. Has designed and placed into successful operation three complete supersonic wind-tunnel testing facilities. Desires to design supersonic wind tunnels, including controls, power plants air drying equipment, pressure and force measuring equipment, and optical instruments for commission.

133. Aeronautical Engineer—Engineering Test Pilot—Registered Professional Aeronautical Engineer. Two degrees, University of Arizona. Graduate work at Cal. Tech., U.C.L.A., and U.S.C. Licensed commercial pilot with helicopter rating. Fifteen years' experience about evenly divided between design, analysis, and testing work on large aircraft; rotating wing aircraft; and teaching. Employed in administrative capacities last 5 years. Age 37; married; loca-

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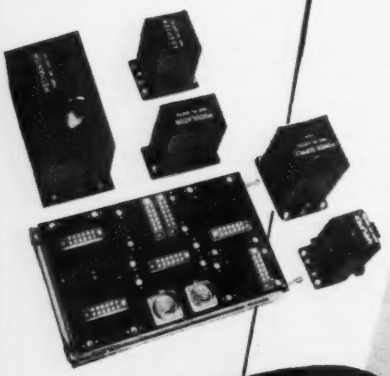

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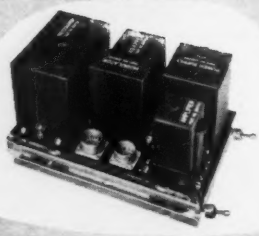

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132. Management or Administration—Age 30; single. A.B. degree, University of Pennsylvania. Major in political administration, courses applicable to business administration. Courses in industrial engineering including industrial relations, business and Government, organization and organizational structure. Aeronautical engineering courses in elementary aerodynamics, performance calculation, aircraft drafting, and engineering. Almost 6 years in aircraft testing in last position. Desires permanent position on junior level in management or administration with opportunity for advancement. Philadelphia, Pa.

131. Industrial Relations Director—Experienced in the practical solution of problems encountered in increasing production and employer-employee understanding through adequate training programs, employee services, and correct public relations. Extensive background covers over 15 years' aeronautical experience in increasingly authoritative and responsible positions, including Instructor, Teacher, Training Superintendent, and Industrial Relations Director. Background includes mechanics (A & E) on-the-job and apprenticeship instruction, vocational education and guidance, conference leadership, preparation and use of teaching aids and demonstration devices, beneficial suggestion and patent systems, work simplification, employment, welfare and recreation activities, cafeteria management, retirement, and insurance. Age 34; married. Desires position in administrative field with air line, industry, or allied field.

130. Aeronautical Engineer—Design, stress, or research. Doctor's Degree. Ten years' industrial experience in responsible design and research capacity. Presently, head of aeronautical option with eastern college. Would consider with interest an outside position for a design, research, and/or development assignment in structures or general air-frame design field. Could dedicate up to 200 engineering man-hours per week by using other faculty members with equivalent industrial experience.

129. Associate Professor—Aeronautical or Mechanical Department. Doctor's Degree. 10 years' industrial experience in supervisory design capacity. Teaching experience in stress analysis, aircraft structures, theory of machines, thermodynamics, fluid mechanics, etc. Wants similar position with university in New York Metropolitan Area or vicinity.

128. Aeronautical Engineer—B.S., M.S. in Ae.E. (R.P.I.). Three years' experience in aircraft field, including design & installation of rocket motors and high-pressure components for missiles; assistant project engineer on high-pressure gas booster, covering contract negotiations, preliminary design, liaison work, testing. Two years' experience in home construction and contracting, involving varied business negotiations; business contacts. Familiar with legal and administrative operation of engineering firm. Six months as instructor at R.P.I. Age 26; married.

126. Aeronautical—Mechanical Engineer—B.S. Aero Engrg., University of Michigan. Age 29. One year's experience in aircraft production, design and stress analysis. Three years' experience in operation and maintenance of Naval aircraft. Four years as project engineer of plant expansion program entailing equipment design, layout, purchasing, installation, and operational follow-up. Holds private pilot's license. Registered Professional Engineer, Commonwealth of Massachusetts. Will complete requirements for B.B.A. in Management, June, 1950. Desires position in planning or development group.

125. Company Representative—Aeronautical Engineer—Test Pilot—B.S. in Ae.E., M.I.T. (1940); also holds A.B. degree; current post-graduate work in aeronautical engineering. Graduate of Navy Test Pilot Training School with

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124. Aeronautical Engineer—B.S. Aeronautical Engineering, M.I.T.: Age 23; single. One year's experience as Liaison Engineer. Three months as draftsman. Interested primarily in stress analysis. Location open.

123. Aeronautical Engineer—B.S. in M.E. (Aero.), June, 1949, Carnegie Institute of Technology. Working as design engineer since graduation. Four years in U.S.A.A.F. as B-26 9th A.F. pilot. Completed 9 months' course as aircraft maintenance officer (partly jet engines). Desires position in aircraft engine industry, preferably jet or rocket. Location open. Age 28; married.

122. Aerodynamicist—Many years' research experience with leading Government organization. Six years with two large aircraft manufacturers. Extensive knowledge of wing characteristics. Considerable experience with wind-tunnel testing and general knowledge of aerodynamics. Married; West Coast preferred.

121. Engineer—Pilot—B.S.M.E. (Aeronautical); 3 years engineering design; 4 years naval aviator; 3 years flight-test engineering; 3,000 hours single- and multiengine; C.A.A. commercial and instrument rating. Prefers pilot position, test, production, or other executive work.

120. Aeronautical Engineer—Graduate of the Academy of Aeronautics course, "Design and Construction." Holds C.A.A.—A. & E. license issued in 1943. Experienced in sheet-metal structures with leading air carrier. Flight engineer with cold Weather Test Detachment in Alaska, service-testing B-17 airplane. Experienced in high-frequency radio control of model aircraft. Desires position in research or testing. Age 26; married. Location open.

119. Aeronautical Engineer—Extensive experience in flight research, wind-tunnel testing, and design, specializing in applied aerodynamics and stability and control. Capable project leader, or will work alone. Age 32. Must locate in California or the Southwest.

Aeronautical Reviews

(*Continued from page 73*)

Data obtained at moderate pressures over a temperature range from 11° to 225°C. shows an average deviation of 3.7 per cent between calculated and observed values for 116 mixtures.

Activity Coefficient Correction Factor Nomograph. Edward G. Scheibel. *Industrial and Engineering Chemistry*, Vol. 41, No. 5, May, 1949, pp. 1076–1079, fig. 7 references.

A set square type of nomograph provides a rapid method for correcting the activity coefficient for liquid pressure and deviations from the perfect-gas laws. Its use is based on the reduced temperature and critical pressure of the pure component and eliminates other empirical charts and calculations required to determine that correction factor. In the usual range of temperatures and pressures, the value obtained from the nomograph agrees with the calculated value almost within the accuracy of reading the scales and within the reliability of the empirical equations upon which it is based.

Equipment for Compressibility Measurements. B. J. Cherney, Henry Marchman, and Robert York, Jr. *Industrial and Engineering Chemistry*, Vol. 41, No. 11, November, 1949, pp. 2653–2658, diagrs. 14 references.

Apparatus for measuring pressure, volume, and temperature characteristics of fluids from room temperature to 300°C. and from 10 to 220 atmospheres, and for vapor pressures, compressibility, and other properties, has an estimated accuracy limit of 0.25 per cent. New propane data are reported.

Entropy and Heat of Formation of Hydrocarbon Vapors. Mott Souders, Jr., C. S. Matthews, and C. O. Hurd. *Industrial and Engineering Chemistry*, Vol. 41, No. 5, May, 1949, pp. 1048–1056, fig. 55 references.

A systematic correlation of entropy and heat of formation over a temperature range from 298.16° to 2,000°K. is based on the premise that thermodynamic functions within a molecule are additive and thus the values for the whole molecule can be built up from an assignment of definite contributions to the groups making up the molecule. Values for the several structural groups necessary for the prediction of those thermodynamic properties in the standard state and of their change with temperature up to 2,000°K. are tabulated. Standard-state entropies of formation as predicted by the method come within ±1.0 entropy unit of the correct value, regardless of the complexity of the hydrocarbon molecule involved. Standard-state heats of formation as predicted are within ±0.5 kg.-cal. per mole. The effect of temperature on each of the thermodynamic functions is predicted within a margin of less than three per cent.

Relationship of Thermodynamic Properties to Molecular Structure; Heat Capacities and Heat Contents of Hydrocarbon Vapors. Mott Souders, Jr., C. S. Matthews, and C. O. Hurd. *Industrial and Engineering Chemistry*, Vol. 41, No. 5, May, 1949, pp. 1037–1048, tables. 51 references.

Systematic correlation methods for the estimation of heat capacities and heat contents of hydrocarbons in the ideal vapor state, developed on the basis of molecular structure, are used in the calculation of tabulation of those values for an extensive list of hydrocarbons at temperatures from −250°F. to 3,000°F. Similar tabulations of the latest values for common gases are included for reference. Differences between heat capacities predicted by the correlation method and by modern experimental measurements are generally less than three per cent. Comparisons with heat capacities and heat contents calculated by the methods of statistical mechanics show differences in most instances of less than two per cent at temperatures above 50°F.

Heat Transfer at High Rates to Water with Surface Boiling. W. H. McAdams, W. E. Kennel, C. S. Minden, Rudolf Carl, P. M. Picornell, and J. E. Dew. *Industrial and Engineering Chemistry*, Vol. 41, No. 9, September, 1949, pp. 1945–1954, illus., diagrs., figs. 23 references.

Because of the extremely high densities of heat flux required in regeneratively-cooled rockets and in other applications involving unusually high rates of heat transfer per unit area, such as in liquid-cooled aircraft engines, a study was made of heat transfer at high density of heat flux from an electrically heated surface to water flowing in tubes. The work was performed by means of apparatus in which degassed distilled water flowed upward through a vertical glass tube containing a centrally located heater of 0.25 in. outside diameter, and determined the quantitative relations between density of heat flux, temperature difference, pressure, degree of subcooling, and water velocity.

The Physical Properties of Air with Reference to Meteorological Practice and the Air-Conditioning Engineer. P. A. Sheppard. *American Society of Mechanical Engineers, Transactions*, Vol. 71, No. 8, November, 1949, pp. 915–919. 2 references.

Thermodynamic Properties of Oxygen, Nitrogen, and Air at Low Temperatures. L. C. Claitor and D. B. Crawford. *American Society of Mechanical Engineers, Transactions*, Vol. 71, No. 8, November, 1949, pp. 885–895, figs. 36 references.

Zero-Pressure Thermodynamic Properties of Carbon Dioxide. Serge Gratch. *American Society of Mechanical Engineers, Transactions*, Vol. 71, No. 8, November, 1949, pp. 897–902. 28 references.

Final Report of the Working Subcommittee of the International Joint Committee on Psychrometric Data. John A. Goff. *American Society of Mechanical Engineers, Transactions*, Vol. 71, No. 8, November, 1949, pp. 903–913. 37 references.

Water-Borne Aircraft (21)

A Theoretical Investigation of Hydrodynamic Impact Loads on Scalloped-Bottom Seaplanes and Comparisons with Experiment. Benjamin Milwitzky. *U.S., N.A.C.A., Report No. 867*, 1947. 16 pp., illus., figs. 6 references. U.S. Govt. Printing Office, Washington. $0.15.

Wind Tunnels (17)

Caltech Tunnel Exceeds Mach 10. *Aviation Week*, Vol. 51, No. 24, December 12, 1949, pp. 30, 33, illus., diagr.

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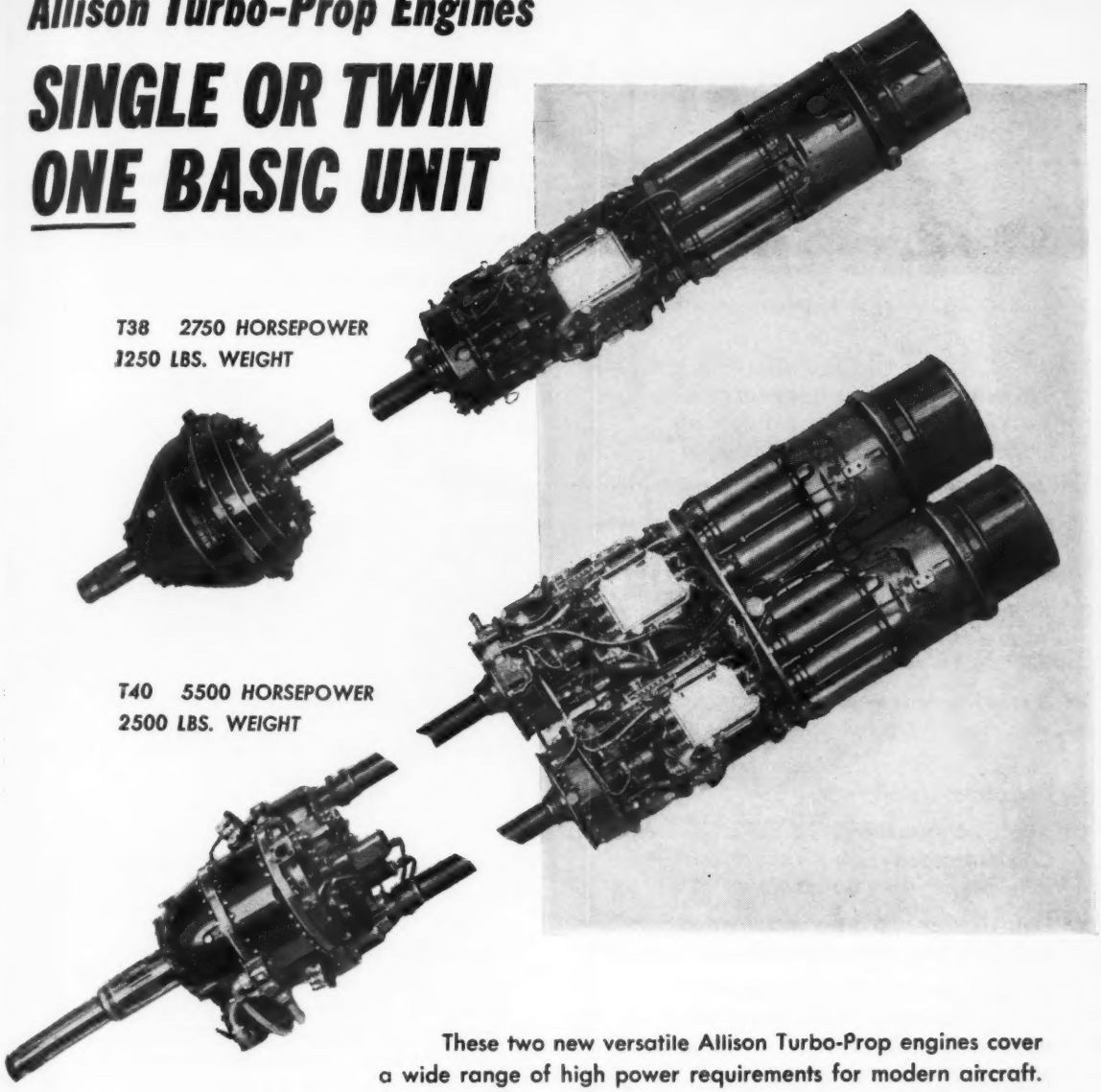

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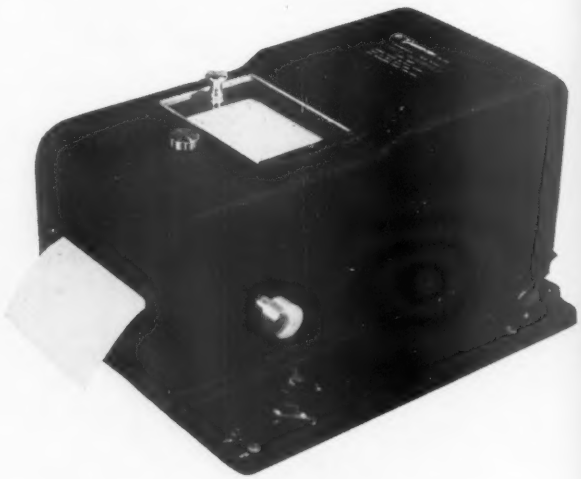

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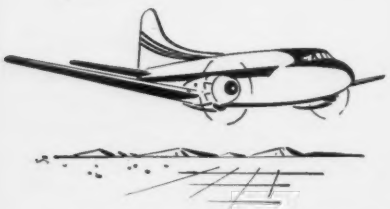

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